

POWER-fin[®]



**UP TO 87%
THERMAL EFFICIENCY**

Dear Design-Build Contractor / Project Manager / Design Engineer,

At Lochinvar, we have long recognized the importance of innovation to any product or service. Those who share in this business also face the challenge of meeting constantly changing needs and energy efficiency demands.

The designer's guide you are now holding has been designed to make it more convenient for you to select the perfect Lochinvar boiler for your projects and provide correct specifications for your teams.

All information has been organized and presented in a succinct, easy-to-use manner, so you can use and share information confidently and with minimal effort.

However, it is important to remember that this guide is not intended to replace our installation manual. Installers should refer to our installation manual for specific installation instructions and more detail. This guide will make regular reference to other documents like the Installation & Operation Manual that are available on the Lochinvar website, www.Lochinvar.com.

We hope this manual will make your work easier and more productive. Thanks again for specifying the Lochinvar family of quality standard and custom-built water heaters and boilers.

Sincerely,



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At Lochinvar, we know that designing a boiler is hard work. Designing a boiler system is no picnic either. Demands for greater efficiency and elaborate system control have made systems more complex.

This designers guide will break down the system requirements that match the Power-fin boiler to assure safe operation, highly efficient heating and long life.

There are five major elements of boiler system design:

Combustion Air

(See page 5)

Venting

(See page 8)

Gas

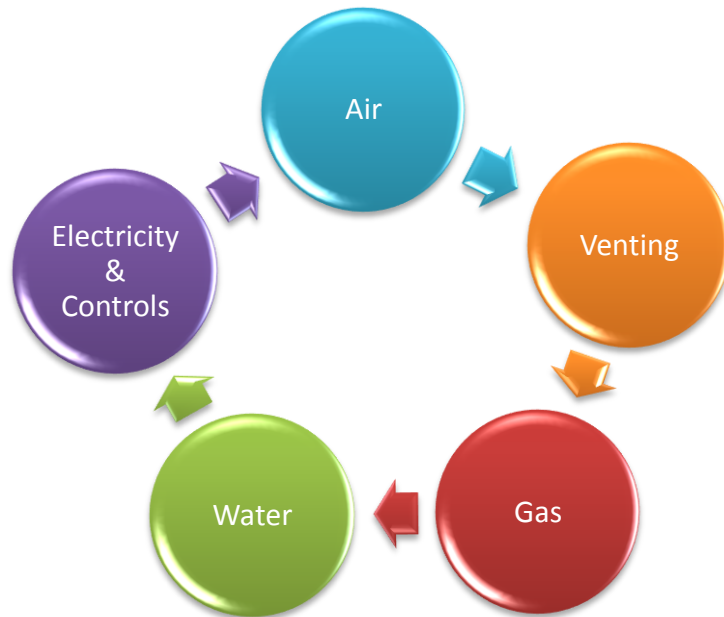
(See page 21)

Water

(See page 23)

Electricity & Controls

(See page 29)



Plus many other important details:

Locations

(See page 34 for "Location of Unit")

Available Options

(See page 35 for "Options")

High Altitude Requirements

(See page 35 for "High Altitude Applications")

Suggested Piping Diagram

(See Appendix Section "A")

Chapter 1 – Combustion and Ventilation Air

Everybody's gotta breathe. Even boilers need air. Air seems easy enough. You stand in the equipment room and you breathe comfortably, don't you? Open a door. Open a window. This is a big room. There's lots of air in here for the boiler.

The average person inhales 400 to 500 cubic feet of air in a 24 hour period. A one million Btu/hr boiler will draw 226.38 cubic feet of air every MINUTE! A 20 by 20 by 8 foot equipment room holds 3200 cubic feet of air. That's a volume of air to last you or me over six days. A one million Btu/hr Power-fin will consume 3200 cubic feet of air in 14 minutes.

Therefore, a good, easy flow of clean air is 100% necessary for clean, efficient combustion. So, we need to provide a permanent and uninterrupted flow of air to the boiler. The Power-fin boiler is designed to receive combustion air by one of TWO methods. The boiler may draw combustion air from the room or have the air ducted directly to the boiler from an exterior space.

This chapter explains the methods for "air from the room". Chapter 2 explains "air ducted directly to the boiler". Again, this chapter lists several techniques to size the air openings that will deliver room air. If there are other appliances in the room requiring air, their air requirements must be including when sizing the air openings.

Provisions for combustion and ventilation air must be designed and installed in accordance with "Air for Combustion and Ventilation", of the latest edition of the National Fuel Gas Code, ANSI Z223.1, (in Canada, the latest edition of CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment) or applicable provisions of the local building codes.



NEGATIVE PRESSURE IN THE EQUIPMENT ROOM

It is important to NEVER have a negative pressure on the equipment room. Exhaust fans are popular in equipment rooms to exchange the air. If the exhaust fan pulls air OUT, then a negative pressure occurs in the room. The combustion and ventilation air must be sized to supply all the equipment PLUS the air for the exhaust fan.

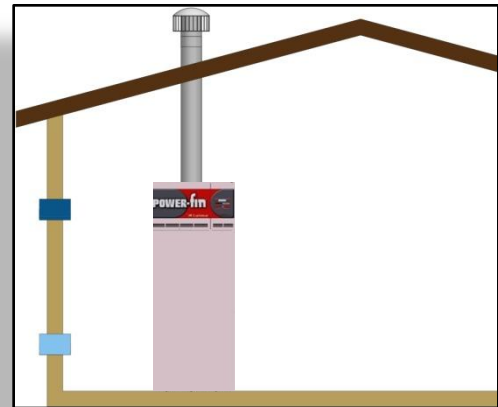
COMBUSTION AND VENTILATION AIR SIZING CALCULATIONS

The sizing calculations in this section are based on "Free Area". The louvers or grill used on the air openings must have a net free area equal to or greater than the value derived in the calculations. The Free Area in a louver or grill is defined as the open, unblocked area. The louvers, grills, mesh, blades, all will block a given amount of space in the louver's overall dimension. Consult the louver manufacturer for exact net free area of the louver.

1. COMBUSTION AIR FROM OUTSIDE

If air is taken directly from outside the building with no duct, provide two permanent openings to the equipment room:

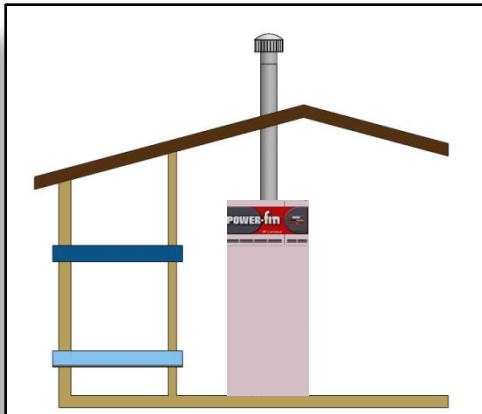
- (a) Combustion air opening, with a minimum free area of one square inch per 4000 Btu/hr input (5.5 cm² per kW). This opening must be located within 12" (30 cm) of the bottom of the enclosure.
- (b) Ventilation air opening, with a minimum free area of one square inch per 4000 Btu/hr input (5.5 cm² per kW). This opening must be located within 12" (30 cm) of the top of the enclosure.



Did you Know?

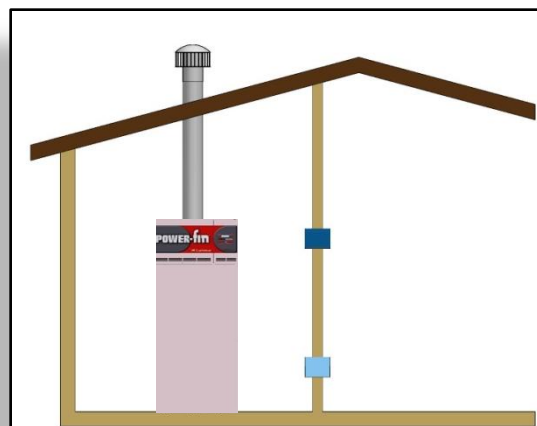


THE POWER-FIN COMES WITH LOUVER CONTACTS AS STANDARD EQUIPMENT. THE CONTACTS WILL OPEN AND CLOSE A MOTORIZED LOUVER ON EACH CALL FOR HEAT.



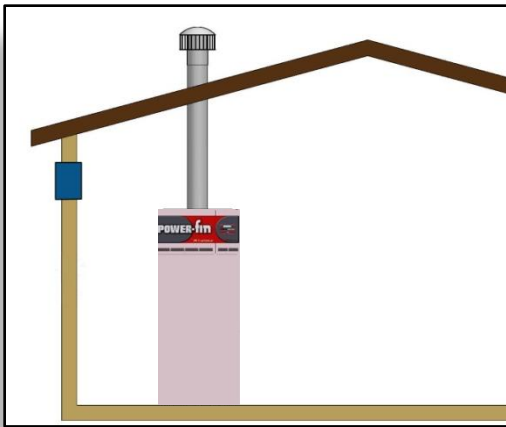
2. COMBUSTION AIR THROUGH DUCTS

If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the equipment room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 Btu/hr (11 cm² per kW) of input.



3. COMBUSTION AIR FROM INTERIOR SPACE

If air is taken from another interior space, each of the two openings specified above should have a net free area of one square inch for each 1000 Btu/hr (22 cm² per kW) of input, but not less than 100 square inches (645 cm²).



4. DIRECT OUTSIDE AIR, SINGLE OPENING

If a single combustion air opening is provided to bring combustion air in directly from the outdoors, the opening must be sized based on a minimum free area of one square inch per 3000 Btu/hr (7 cm² per kW). This opening must be located within 12" (30 cm) of the top of the enclosure.

Caution

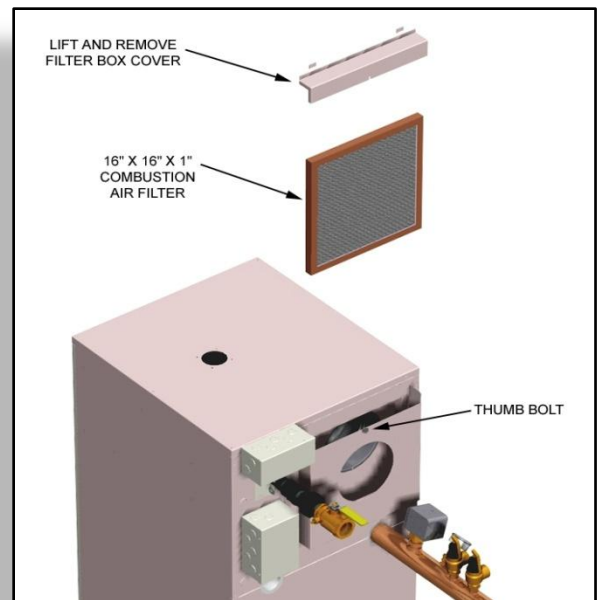


THE COMBUSTION AIR MUST BE FREE OF ANY CONTAMINANTS OR CHEMICAL FUMES. SALTS, REFRIGERANTS AND SOLVENTS INTRODUCED INTO THE COMBUSTION PROCESS WILL RESULT IN THE FORMATION OF CORROSIVE ACIDS THAT WILL DAMAGE THE APPLIANCE AND THE VENT.

COMBUSTION AIR FILTER

The Power-fin has a built-in air filter as standard equipment. Located at the combustion air inlet, the air filter is provided to help ensure clean air is used for the combustion process.

The filter size on models 502-1302 is 16" x 12" x 1" (40.6 cm x 30.4 cm x 2.5 cm) and on models 1501 - 2001 is 16" x 16" x 1" (40.6 cm x 40.6 cm x 2.5 cm). You can find these commercially available filters at any home center or plumbing supply store.



Chapter 2 – Venting

Venting is a difficult design element for the installation of a gas fired appliance. It has a variety of choices, it has several available vent configurations, it has the important rules and regulations that govern the installation and most important of all, it bears a requirement for human safety.

Warning



SPILLAGE OF FLUE PRODUCTS AND CARBON MONOXIDE EMISSIONS PRODUCED BY THE COMBUSTION PROCESS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

Lochinvar offers twelve different vent configurations on the Power-fin boiler to meet the building's requirements. There are six layouts or footprints across three different vent categories. They are...

- Vertical Vent with Air from the Equipment Room
- Vertical Vent with Air from the Rooftop
- Vertical Vent with Air from the Sidewall
- Sidewall Vent with Air from the Equipment Room
- Sidewall Vent with Air from the Rooftop
- Sidewall Vent with Air from the Sidewall

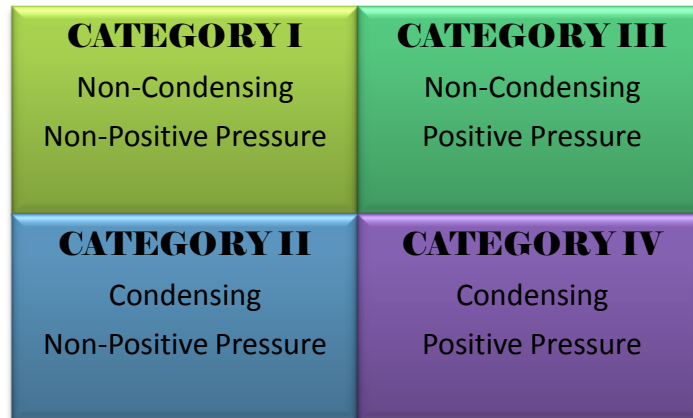
- Category I, Category II or Category IV
- Category I, Category II or Category IV
- Category I, Category II or Category IV
- Category IV only
- Category IV only
- Category IV only

That's a lot of choices. Plus there is an important new consideration about specifying the correct Firing Code. Allow me to overexplain.

Venting

Part 1 Vent Categories

Here is the traditional vent category diagram, standard throughout the industry. Lochinvar offers twelve venting options that allow the Power-fin to be installed in any of three categories - Category I, Category II and Category IV. Depending upon the "Firing Code" chosen, the Power-fin boiler will be factory trimmed for direct connection either Category I or Category IV venting. Part 2 explains "Firing Codes" and their relationship to Category I and Category IV. We'll explain Category II later.



The four basic Vent Categories are determined by two characteristics, Condensation and Pressure.

CONDENSING VERSUS NON-CONDENSING

The possibility for condensation to form in a stack is based on the temperature of the flue products. If the temperature of the flue products remains consistently above dewpoint, condensation will not form. If the temperature drops below dewpoint, condensation will form.

So how does condensation apply to the Power-fin? Easy. The Power-fin's firing rate determines the stack temperature. Depending upon the model, the Power-fin may operate at a high firing rate producing a high stack temperature to stay above dewpoint or it may modulate down to a low firing rate producing a low stack temperature that allows the flue gas temperature to drop below dewpoint. This is explained further in Part 2, "Firing Code".

POSITIVE VERSUS NON-POSITIVE

Positive or non-positive pressure in the vent is determined by the capacity of the appliance's blower AND the diameter of the vent in order to PUSH the flue products. If the same appliance is connected to a larger diameter stack, the blower CANNOT PUSH the flue products. The positive pressure goes negative, or non-positive.

So how does pressure apply to the Power-fin? Again, easy. Depending upon the model, the Power-fin boiler's will be factory trimmed for a small vent connection to positive vent or a large vent connection to non-positive vent. This is explained further in Part 2, "Firing Code".

Part 2 Firing Codes

The model number for all Lochinvar products has a "Firing Code".

Example: PBN0752-M9

"PBN0752" is the basic model number / "M9" is the Firing Code.

This collection of letters and numbers has a specific meaning. The Firing Code is important because it specifies a particular feature set that is factory trimmed to match the planned venting system. With the correct firing code, Lochinvar will factory trim your boiler to fire at correct input rate and provide the correct vent connection to meet your needs.

There are THREE basic firing codes. Here's how they work.

F9 models / Power-fin 0502-1302 only

"F9" means "Full Fire" or 100% Full Fire with no modulation. (No Turndown)

Temperature – Firing at 100% of input rate, the Power-fin 0502-1302-F9 models will always produce a high stack temperature. Non-Condensing.

Pressure – The Power-fin 0502-1302-F9 models are factory trimmed with a large diameter vent connection. The blower CANNOT PUSH the flue products through a similarly sized stack therefore creating a non-positive pressure. Non-Positive Pressure.

F9 models are Category I.

B9 models / Power-fin 1501-2001 only

"B9" means "Bi-level Fire" or 50% to 100% firing rate. (2:1 Turndown)

Temperature – Even firing at the lowest input rate of 50%, the Power-fin 1501-2001-B9 models will produce a high stack temperature. Non-Condensing.

Pressure –The Power-fin 1501-2001-B9 models are factory trimmed with a large diameter vent connection. The blower CANNOT PUSH the flue products through a similarly sized stack therefore creating a non-positive pressure. Non-Positive Pressure.
B9 models are Category I.

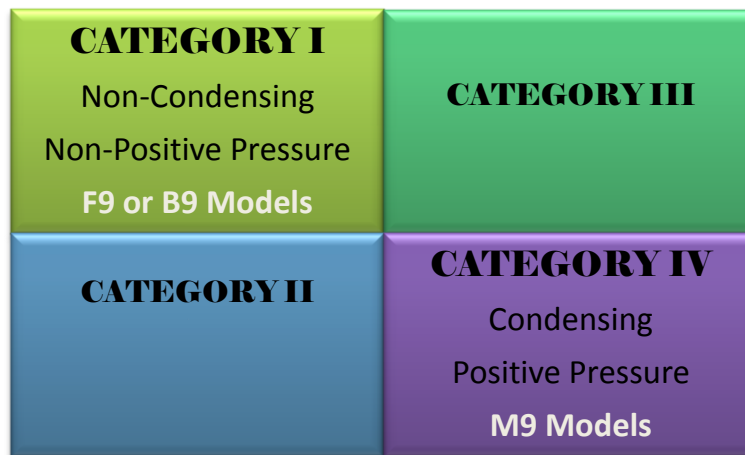
M9 models / Power-fin 0502-2001

“M9” means “Modulating” Fire or 20% to 100% firing rate. (5:1 Turndown)

Temperature – When the Power-fin 0502-2001-M9 models modulate down to their lowest input rate of 20%, they produce a comparatively low stack temperature that will likely cause condensation to occur in the stack. Condensing.

Pressure – The Power-fin 0502-2001-M9 models are factory trimmed with a small diameter vent connection. The blower CAN PUSH the flue products through a similarly sized stack therefore creating a positive pressure. Positive Pressure.

M9 models are Category IV.



Part 3

Choose your vent configuration

Now, that you know your vent category and the matching Firing Code, it's time to choose the vent configuration or system layout. Let's start with Category IV venting.

Category IV Venting

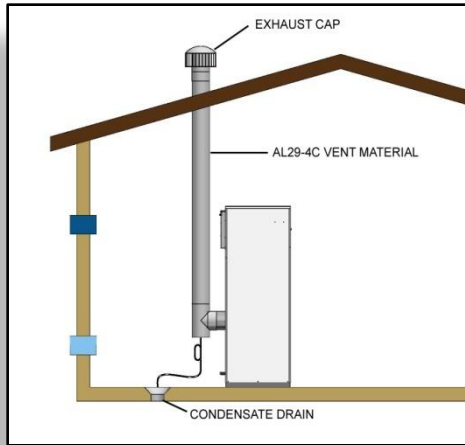
This is likely to be the most common because it offers modulation and it offers the largest variety of vent configurations. All six layouts listed on page eight can be installed as Category IV venting. The following pages offer a diagram of the six layouts, important design information and a list of the available vent kits that are required to install some of these configurations.

- Vertical Vent with Air from the Equipment Room
- Vertical Vent with Air from the Rooftop
- Vertical Vent with Air from the Sidewall
- Sidewall Vent with Air from the Equipment Room
- Sidewall Vent with Air from the Rooftop
- Sidewall Vent with Air from the Sidewall

- Category IV
- Category IV
- Category IV
- Category IV only
- Category IV only
- Category IV only

**CATEGORY IV VENTING – “M9” FIRING CODE
 VERTICAL VENT WITH COMBUSTION AIR FROM EQUIPMENT ROOM.**

The flue outlet terminates on the rooftop. The combustion air is drawn naturally from the equipment room.



BULLET POINTS

- Category IV vent material is required, such as AL29-4C.
- All vent joints and seams must be sealed gastight and may not be common vented.
- The vent must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the vent pipe.
- All vent material for this configuration including vent termination will be obtained locally.
- The air is delivered to the equipment room by means defined in Chapter 1 of this designer's guide.
- Maximum distance – 50 equivalent feet of vent.

The Category IV Power-fin with a model number that features the M9 (Modulating Fire) Firing Code will be factory trimmed for Category IV vent connection in the following dimensions.

MODEL	CAT IV VENT CONNECTION
PBN0502-M9	4"
PBN0752-M9	5"
PBN1002-M9	6"
PBN1302-M9	8"
PBN1501-M9	6"
PBN1701-M9	7"
PBN2001-M9	8"

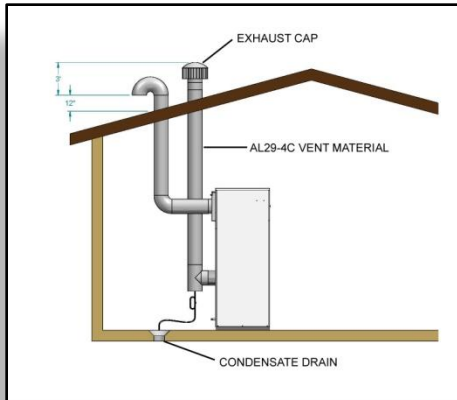
Tip



THIS CONFIGURATION MAY BE INSTALLED AS CATEGORY II. SEE PAGE 17 FOR DETAILS.

**CATEGORY IV VENTING – “M9” FIRING CODE
 VERTICAL VENT WITH COMBUSTION AIR FROM THE ROOFTOP.**

The flue outlet terminates on the rooftop. The combustion air is ducted to the appliance from outdoors through the rooftop. This is true Direct Vent with the flue termination and the air inlet port in the same pressure zone.



BULLET POINTS

- Category IV vent material is required, such as AL29-4C.
- All vent joints and seams must be sealed gastight and may not be common vented.
- The vent must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the vent pipe.
- All other vent material for this configuration including vent termination will be obtained locally.
- The air is delivered to the appliance via a separate duct. The air intake material can be galvanized pipe, PVC, CPVC or ABS and must be sealed airtight.
- Maximum distance – 50 equivalent feet of vent.
- Maximum distance – 50 equivalent feet of air intake.

The Category IV Power-fin with a model number that features the M9 (Modulating Fire) Firing Code will be factory trimmed for Category IV vent and air inlet connections in the following dimensions.

MODEL	CAT IV VENT CONNECTION	AIR INLET CONNECTION
PBN0502-M9	4"	5"
PBN0752-M9	5"	5"
PBN1002-M9	6"	6"
PBN1302-M9	8"	6"
PBN1501-M9	6"	6"
PBN1701-M9	7"	7"
PBN2001-M9	8"	8"

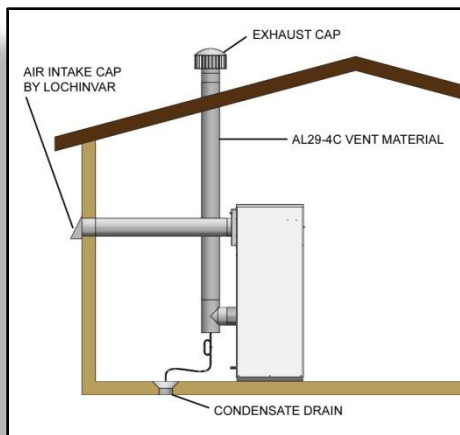
Tip



THIS CONFIGURATION MAY BE INSTALLED AS CATEGORY II. SEE PAGE 17 FOR DETAILS.

**CATEGORY IV VENTING – “M9” FIRING CODE
 VERTICAL VENT WITH COMBUSTION AIR FROM THE SIDEWALL
 (DirectAire).**

The flue outlet terminates on the rooftop. The combustion air is ducted to the appliance from outdoors through the sidewall. This is not true Direct Vent with the flue termination and the air inlet port in different pressure zones.



BULLET POINTS

- Category IV vent material is required, such as AL29-4C.
- All vent joints and seams must be sealed gastight and may not be common vented.
- The vent must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the vent pipe.
- The sidewall exhaust cap must be provided by Lochinvar. See table below for kit part numbers. All other vent material for this configuration will be obtained locally.
- The air is delivered to the appliance via a separate duct. The air intake material can be galvanized pipe, PVC, CPVC or ABS and must be sealed airtight.
- Maximum distance – 50 equivalent feet of vent.
- Maximum distance – 50 equivalent feet of air intake.

The Category IV Power-fin with a model number that features the M9 (Modulating Fire) Firing Code will be factory trimmed for Category IV vent and air inlet connections in the following dimensions. The table also includes the kit part numbers for the sidewall exhaust caps which must be used.

MODEL	CAT IV VENT CONNECTION	AIR INLET CONNECTION	SAK KIT NUMBER
PBN0502-M9	4"	5"	SAK3003
PBN0752-M9	5"	5"	SAK3003
PBN1002-M9	6"	6"	SAK3004
PBN1302-M9	8"	6"	SAK3004
PBN1501-M9	6"	6"	SAK3004
PBN1701-M9	7"	7"	SAK3005
PBN2001-M9	8"	8"	SAK3006

The main component in Sidewall Air Intake Kit is the Sidewall Air Intake Cap.



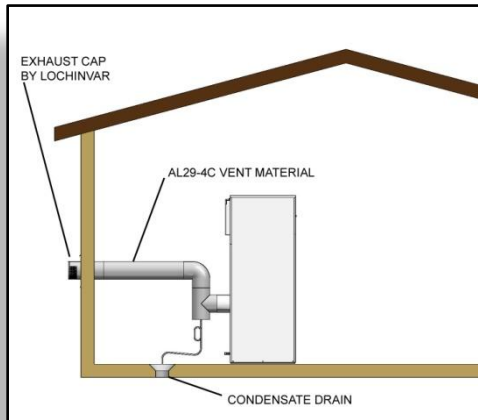
Tip



THIS CONFIGURATION MAY BE INSTALLED AS CATEGORY II. SEE PAGE 17 FOR DETAILS.

**CATEGORY IV VENTING – “M9” FIRING CODE
 SIDEWALL VENT WITH COMBUSTION AIR FROM EQUIPMENT ROOM.**

The flue outlet terminates out the sidewall. The combustion air is drawn naturally from the equipment room.



BULLET POINTS

- Category IV vent material is required, such as AL29-4C.
- All vent joints and seams must be sealed gastight and may not be common vented.
- The vent must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the vent pipe.
- The sidewall exhaust cap must be provided by Lochinvar. See table below for kit part numbers. All other vent material for this configuration will be obtained locally.
- The air is delivered to the equipment room by means defined in Chapter 1 of this designer's guide.
- Maximum distance - 50 equivalent feet of vent.

The Category IV Power-fin with a model number that features the M9 (Modulating Fire) Firing Code will be factory trimmed for Category IV vent connection in the following dimensions. The table also includes the kit part numbers for the sidewall exhaust caps which must be used.

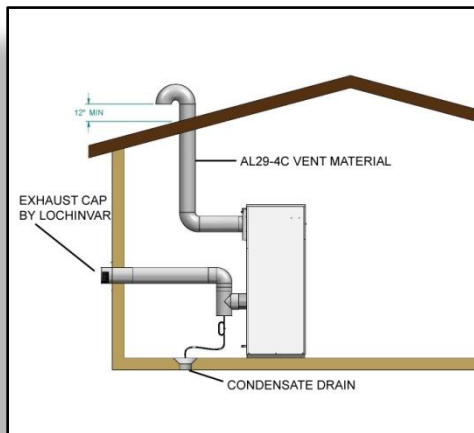
MODEL	CAT IV VENT CONNECTION	SVK KIT NUMBER
PBN0502-M9	4"	SVK3069
PBN0752-M9	5"	SVK3070
PBN1002-M9	6"	SVK3018
PBN1302-M9	8"	SVK3068
PBN1501-M9	6"	SVK3018
PBN1701-M9	7"	SVK3019
PBN2001-M9	8"	SVK3068

The main component in Sidewall Vent Kit is the Sidewall Exhaust Cap.



**CATEGORY IV VENTING – “M9” FIRING CODE
 SIDEWALL VENT WITH COMBUSTION AIR FROM THE ROOFTOP
 (DirectAire).**

The flue outlet terminates out the sidewall. The combustion air is ducted to the appliance from outdoors through the rooftop. This is not true Direct Vent with the flue termination and the air inlet port in different pressure zones.



BULLET POINTS

- Category IV vent material is required, such as AL29-4C.
- All vent joints and seams must be sealed gastight and may not be common vented.
- The vent must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the vent pipe.
- The sidewall exhaust cap must be provided by Lochinvar. See table below for kit part numbers. All other vent material for this configuration will be obtained locally.
- The air is delivered to the appliance via a separate duct. The air intake material can be galvanized pipe, PVC, CPVC or ABS and must be sealed airtight.
- Maximum distance - 50 equivalent feet of vent.
- Maximum distance - 50 equivalent feet of air intake.

The Category IV Power-fin with a model number that features the M9 (Modulating Fire) Firing Code will be factory trimmed for Category IV vent and air inlet connections in the following dimensions. The table also includes the kit part numbers for the sidewall exhaust caps which must be used.

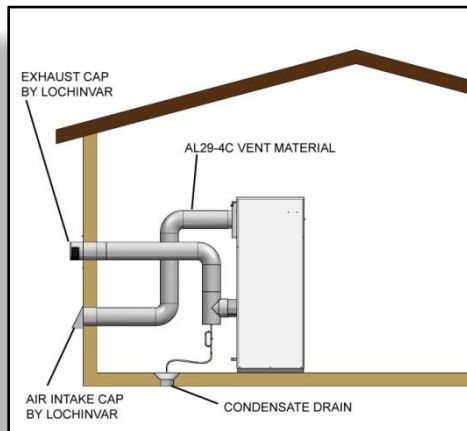
MODEL	CAT IV VENT CONNECTION	AIR INLET CONNECTION	SVK KIT NUMBER
PBN0502-M9	4"	5"	SVK3069
PBN0752-M9	5"	5"	SVK3070
PBN1002-M9	6"	6"	SVK3018
PBN1302-M9	8"	6"	SVK3068
PBN1501-M9	6"	6"	SVK3018
PBN1701-M9	7"	7"	SVK3019
PBN2001-M9	8"	8"	SVK3068

The main component in Sidewall Vent Kit is the Sidewall Exhaust Cap.



**CATEGORY IV VENTING – “M9” FIRING CODE
 SIDEWALL VENT WITH COMBUSTION AIR FROM THE SIDEWALL.**

The flue outlet terminates out the sidewall. The combustion air is ducted to the appliance from outdoors through the sidewall. This is true Direct Vent with the flue termination and the air inlet port in the same pressure zone.



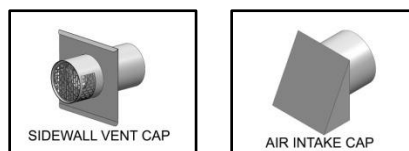
BULLET POINTS

- Category IV vent material is required, such as AL29-4C.
- All vent joints and seams must be sealed gastight and may not be common vented.
- The vent must have a condensate drain with provisions to properly collect and dispose of any condensate that may occur in the vent pipe.
- The sidewall exhaust cap and the sidewall air intake cap must be provided by Lochinvar. See table below for kit part numbers. All other vent material for this configuration will be obtained locally.
- The air is delivered to the appliance via a separate duct. The air intake material can be galvanized steel pipe, PVC, CPVC or ABS and must be sealed airtight.
- Maximum distance - 50 equivalent feet of vent.
- Maximum distance - 50 equivalent feet of air intake.

The Category IV Power-fin with a model number that features the M9 (Modulating Fire) Firing Code will be factory trimmed for Category IV vent and air inlet connections in the following dimensions. The table also includes the kit part numbers for the sidewall exhaust caps and air intake caps which must be used.

MODEL	CAT IV VENT CONNECTION	AIR INLET CONNECTION	HDK KIT NUMBER
PBN0502-M9	4"	5"	HDK3052
PBN0752-M9	5"	5"	HDK3053
PBN1002-M9	6"	6"	HDK3049
PBN1302-M9	8"	6"	HDK3054
PBN1501-M9	6"	6"	HDK3049
PBN1701-M9	7"	7"	HDK3050
PBN2001-M9	8"	8"	HDK3051

The main components in the Horizontal Direct Vent Kit are the Sidewall Exhaust Cap and the Sidewall Air Intake Cap.



Final note about Category IV

Retrofit of an original design Power-fin installed with Concentric Kit

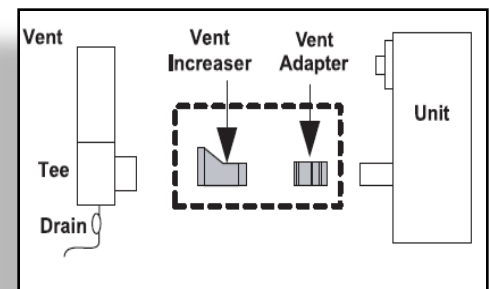
If your job is a retrofit of a Power-fin 0250-1000 built to the original design, here's a little tip. If the PBN0250-F9, PBN0500-F9, PBN0750-F9 or PBN1000-F9 is installed with a concentric vent kit, it is installed as a Category IV appliance. The "F9" firing code on the original Power-fin is not 100% equal to the "F9" firing code on the new Power-Fin. An original Power-fin installed with concentric vent more closely matches the "M9" models. Therefore, when specifying the new replacement, remember to check the type of vent system currently installed.

Category II Venting

An important detail in the Category IV section is Category IV venting MAY NOT be common vented. Category IV is positive pressure stack and you cannot combine positive pressure stacks. This is where switching to Category II can be useful.

We take the standard Power-fin "M9 Firing Code" with its low Btu/hr input and low stack temperature and we increase the stack diameter. That changes the stack pressure from positive to non-positive. Plus the stack will remain a condensing stack because of the potential for low Btu/hr input and corresponding low stack temperature. This changes the vent Category from IV to II.

Of the six layouts listed on page 8, three can be installed as Category II venting. Notice that only vertical termination is permissible with Category II venting.



- Vertical Vent with Air from the Equipment Room** **Category II**
- Vertical Vent with Air from the Rooftop** **Category II**
- Vertical Vent with Air from the Sidewall** **Category II**

There are three important considerations when specifying Category II venting.

CATEGORY I Non-Condensing Non-Positive Pressure F9 or B9 Models	CATEGORY III
CATEGORY II Condensing Non-Positive Pressure M9 w/ Vent Increaser	CATEGORY IV Condensing Positive Pressure M9 Models

1. The Power-fin **MUST** be M9 Firing Code. The appliance will have modulating fire and a Category IV vent connection.
2. A special vent adapter **MUST** be specified to convert the appliance from Category IV vent diameters to Category II vent diameters. The increase in vent diameter is crucial to change from Category IV positive pressure to Category II non-positive pressure.
3. The combined vent **MUST** be properly sized for the combined appliances.

The Category II kits are as follows:

MODEL	VENT CONNECTION INCREASER	KIT NUMBER
PBN0502-M9	4" to 7"	KIT3131
PBN0752-M9	5" to 9"	KIT3132
PBN1002-M9	6" to 10"	KIT3133
PBN1302-M9	8" to 12"	KIT3134
PBN1501-M9	6" to 8"	KIT3106
PBN1701-M9	7" to 9"	KIT3107
PBN2001-M9	8" to 10"	KIT3108

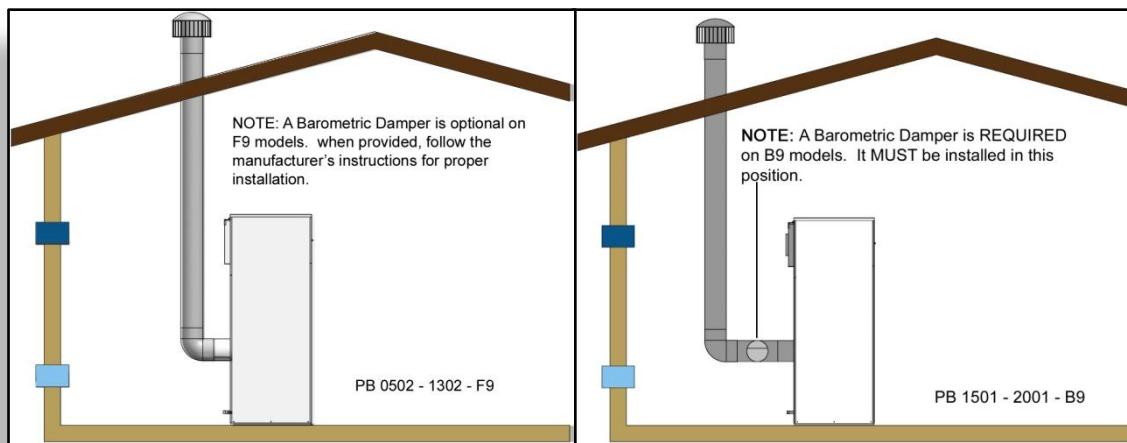
Category I Venting

Of the six layouts listed on page 8, three can be installed as Category I venting. The following offers a diagram of the three layouts, important design information and a list of the available vent kits that are required to install in these configurations. Notice that only vertical termination is permissible with Category I venting.

Vertical Vent with Air from the Equipment Room Category I
 Vertical Vent with Air from the Rooftop Category I
 Vertical Vent with Air from the Sidewall Category I

CATEGORY I VENTING – “F9” OR “B9” FIRING CODE VERTICAL VENT WITH COMBUSTION AIR FROM EQUIPMENT ROOM.

The flue outlet terminates on the rooftop. The combustion air is drawn naturally from the equipment room.



BULLET POINTS

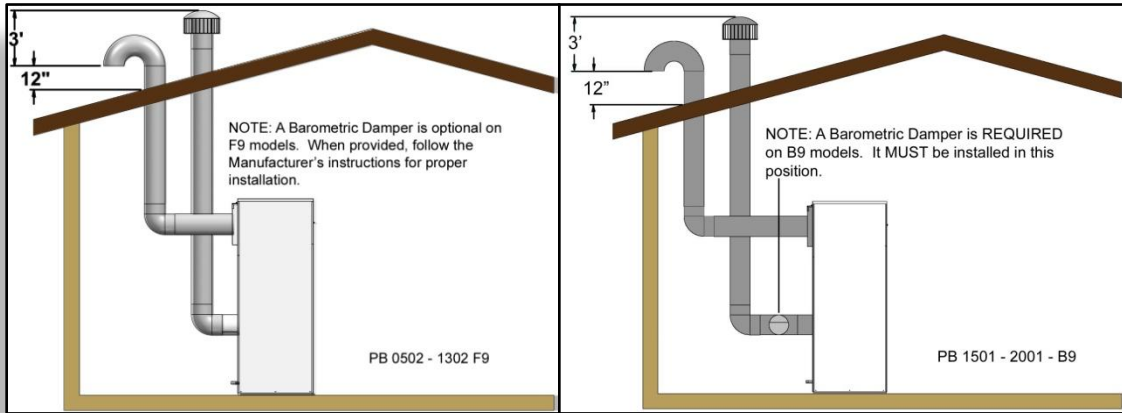
- Category I double wall “B” vent is required.
- All vent material for this configuration including vent termination will be obtained locally.
- The air is delivered to the equipment room by means defined in Chapter 1.
- A field supplied barometric damper is optional on Power-fin 0502-1302-F9.
- A field supplied barometric damper **MUST** be installed on Power-fin 1501-2001-B9.

The Category I Power-fin with a model number that features the F9 or B9 Firing Code will be factory trimmed for Category I vent connection in the following dimensions.

MODEL	CAT I VENT CONNECTION
PBN0502-F9	7"
PBN0752-F9	9"
PBN1002-F9	10"
PBN1302-F9	12"
PBN1501-B9	12"
PBN1701-B9	14"
PBN2001-B9	14"

**CATEGORY I VENTING – “F9” OR “B9” FIRING CODE
 VERTICAL VENT WITH COMBUSTION AIR FROM THE ROOFTOP
 (DirectAire).**

The flue outlet terminates on the rooftop. The combustion air is ducted to the appliance from outdoors through the rooftop.



BULLET POINTS

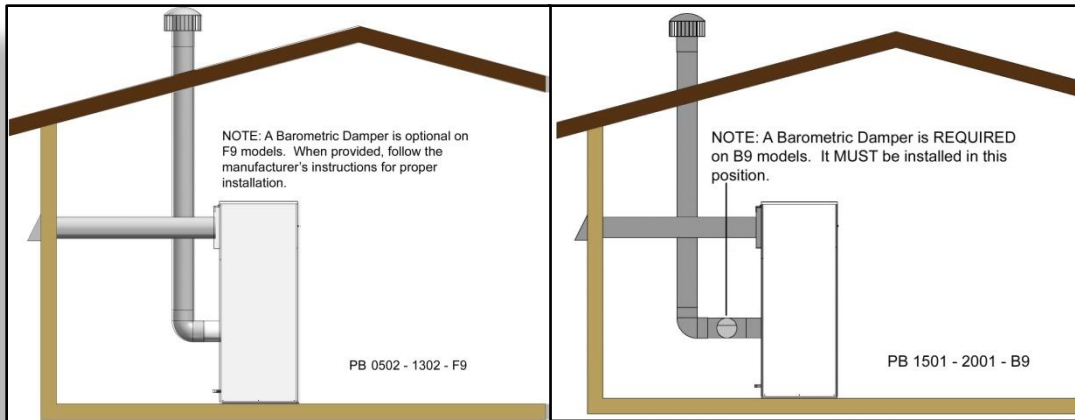
- Category I double wall “B” vent is required.
- All vent material for this configuration including vent termination will be obtained locally.
- The air is delivered to the appliance via a separate duct. The air intake material can be PVC, CPVC or ABS, galvanized steel pipe, double wall “B” vent, etc
- A field supplied barometric damper is optional on Power-fin 0502-1302-F9.
- A field supplied barometric damper **MUST** be installed on Power-fin 1501-2001-B9.
- Maximum distance - 50 equivalent feet of air intake.

The Category I Power-fin with a model number that features the F9 or B9 Firing Code will be factory trimmed for Category I vent and air inlet connections in the following dimensions.

MODEL	CAT I VENT CONNECTION	AIR INLET CONNECTION
PBN0502-F9	7"	5"
PBN0752-F9	9"	5"
PBN1002-F9	10"	6"
PBN1302-F9	12"	6"
PBN1501-B9	12"	6"
PBN1701-B9	14"	7"
PBN2001-B9	14"	8"

**CATEGORY I VENTING – “F9” OR “B9” FIRING CODE
VERTICAL VENT WITH COMBUSTION AIR FROM THE SIDEWALL
(DirectAire).**

The flue outlet terminates on the rooftop. The combustion air is ducted to the appliance from outdoors through the sidewall.



BULLET POINTS

- Category I double wall “B” vent is required.
- The sidewall exhaust cap must be provided by Lochinvar. See table below for kit part numbers. All other vent material for this configuration will be obtained locally.
- The air is delivered to the appliance via a separate duct. The air intake material can be PVC, CPVC or ABS, galvanized steel pipe, double wall “B” vent, etc.
- A field supplied barometric damper is optional on Power-fin 0502-1302-F9.
- A field supplied barometric damper **MUST** be installed on Power-fin 1501-2001-B9.
- Maximum distance - 50 equivalent feet of air intake.

The Category I Power-fin with a model number that features the F9 or B9 Firing Code will be factory trimmed for Category I vent and air inlet connections in the following dimensions. The table also includes the kit part numbers for the sidewall air intake caps which must be used.

MODEL	CAT I VENT CONNECTION	AIR INLET CONNECTION	SAK KIT NUMBER
PBN0502-F9	7"	5"	SAK3003
PBN0752-F9	9"	5"	SAK3003
PBN1002-F9	10"	6"	SAK3004
PBN1302-F9	12"	6"	SAK3004
PBN1501-B9	12"	6"	SAK3004
PBN1701-B9	14"	7"	SAK3005
PBN2001-B9	14"	8"	SAK3006

The main component in Sidewall Air Intake Kit is the Sidewall Air Intake Cap.



Chapter 3 – Gas Supply

Lochinvar products are designed with the concept of flame control. We develop combustion systems that tightly control the flow of air and gas to deliver a clean and efficient burn. In Chapters 1 and 2, we showed the various methods to deliver an ample quantity of air to the appliance. In Chapter 3, we discuss delivering a steady and reliable supply of gas to the appliance.

The key to the gas supply is sizing the gas line properly. The Power-fin will require less than a half a pound of pressure. The following Sizing Chart is based on less than ½ pound of pressure or less than 14 inches of pressure. The table is derived from the ANSI Z223.1, the National Fuel Gas Code.

Simply calculate the total linear feet of straight gas pipe. Figure each elbow as equal to five straight feet of pipe. Working down the column that matches your pipe length, find the value GREATER THAN the total Btu/hr input of the boiler or boilers. This will identify the minimum nominal iron pipe size.

GAS PIPE SIZING CHART														
Nominal Iron Pipe Size	Length of Pipe in Straight Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/4"	369	256	205	174	155	141	128	121	113	106	95	86	79	74
1"	697	477	384	328	292	267	246	256	210	200	179	164	149	138
1 1/4"	1,400	974	789	677	595	543	502	472	441	410	369	333	308	287
1 1/2"	2,150	1,500	1,210	1,020	923	830	769	707	666	636	564	513	472	441
2"	4,100	2,820	2,260	1,950	1,720	1,560	1,440	1,330	1,250	1,180	1,100	974	871	820
2 1/2"	6,460	4,460	3,610	3,100	2,720	2,460	2,310	2,100	2,000	1,900	1,700	1,540	1,400	1,300
3"	11,200	7,900	6,400	5,400	4,870	4,410	4,000	3,800	3,540	3,300	3,000	2,720	2,500	2,340
4"	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720

The Power-fin features a Negative-Regulation or Neg-Reg gas combustion system. The gas is introduced upstream of the combustion blower. As the blower draws air in, the negative pressure on the inlet of the blower pulls the gas from the gas valve. The gas/air mixture is pushed through the blower into the burner. The gas/air mixture filters through the ceramic burner mesh and is ignited by the Hot Surface Igniter.

On full fire, a crisp blue flame rises off the surface of the burner. As demand decreases, the operating control reduces the blower speed. The flame is reduced and touches the burner surface. The ceramic burner material is designed to burn infra-red safely without being damaged by direct contact of the flame. Even at this reduced Btu/hr input, the gas/air mixture is balanced to provide clean, efficient combustion.



The list below shows the gas connection size on the boiler. Logically, the gas pipe size from the meter to the boiler may be larger than the appliance connection.

MODEL	PIPE SIZE		MODEL	PIPE SIZE
PBN0502	1"		PBN1501	2"
PBN0752	1-1/4"		PBN1701	2"
PBN1002	1-1/4"		PBN2001	2"
PBN1302	1-1/4"			

The table below lists the Minimum and Maximum Inlet Gas Pressures. Note how the B9, F9 and M9 models have different requirements.

INLET GAS PRESSURE					
Model Number	Firing Code	NATURAL GAS		L.P. GAS	
		Max. w.c.	Min. w.c.	Max. w.c.	Min. w.c.
PBN0502 - 1302	F9	10.5	4.2	13.0	11.0
PBN0502 - 1302	M9	14.0	4.0	13.0	11.0
PBN1501 - 2001	B9	14.0	4.0	14.0	8.0
PBN1501 - 2001	M9	14.0	4.0	14.0	8.0

L.P. GAS MODELS

If you are specifying a model for connection to L.P. gas, make sure that is noted on your design specification. Example, the model number changes from PBN0502-M9 to PBL0502-M9 from natural to L.P. gas. The Power-fin must be factory trimmed for the chosen gas type and may not be field converted from Natural to L.P. gas or vice versa.

GAS PRESSURE REGULATORS

Lochinvar recommends the use of "Lock-Up Type" gas pressure regulators on the system gas supply. A Lock-Up Type gas pressure regulator features a seat that seals the regulator orifice when the appliance is off and there is no demand for gas. The seat will seal against the orifice shutting off the flow of gas to the appliance.

A standard regulator without a Lock-Up mechanism will allow the system pressure to reach the boiler when it is off. The system pressure can "creep up" pressing against the appliance gas train with excessive system pressures. This can damage the components in the gas train.

Important



HIGH PRESSURE GAS REGULATORS MUST BE THE LOCK-UP VARIETY AND MUST BE INSTALLED NOT LESS THAN 10 EQUIVALENT FEET FROM THE BOILER TO PROVIDE AN ADEQUATE VOLUME OF GAS FOR SMOOTH IGNITION.

Chapter 4 – Water

We are no longer designing the giant, lumbering gravity-feed boiler systems of our grandfathers. Buildings are bigger and more complex. Energy efficiency and “green” building demands have requirements for precise flow, for targeted temperatures, for low water volume and more. They also demand a water piping system that will not only meet the demands of the building but also not damage the boiler.

IMPORTANT BULLET POINTS FOR WATER PIPING

- 1. Water Connections**
All models have 2 1/2 inch copper sweat pipe inlet and outlet connections.
Installed piping to and from the boiler must be a minimum of 2 1/2 inch diameter.
- 2. Maximum Flow Rate**
The Power-Fin 502-1302 models have a max flow rate of 75 GPM.
The Power-Fin 1501-2001 models have a max flow rate of 90 GPM.
- 3. Working Pressure**
The boiler should not be operated at less than 12 PSIG.
- 4. Minimum Inlet Water Temperature**
The minimum inlet water temperature returned to the boiler is 140°F (60°C).
- 5. Flow Rate**
The boiler requires a constant flow rate through the heat exchanger. Do not vary the flow rate through the boiler during a call for heat.
- 6. Unions and Ball Valves**
The water piping to the boiler should have unions and ball valves at the inlet and outlet of the boiler to isolate the boiler for service. Use only full port ball valves.

There are three major concepts to consider when designing the near boiler piping system. They are...

WATER FLOW

WATER TEMPERATURE

WATER VOLUME

Basically, a boiler or bank of boilers has a given range of operation under these three concepts. A boiler has a water flow rate range. A boiler has a water temperature range. A boiler has a water volume range. If you design a system that lets the boiler operate within its comfort zone, it lives a long and prosperous life. If the system forces the boiler to operate outside any one of the three comfort zones; the boiler suffers.

WATER FLOW

The flow rate question is easy. Maximum Flow Rate and Minimum Flow Rate.

Does the maximum planned flow rate for the system loop exceed the maximum allowable flow rate through the boiler?

The maximum flow rate for the Power-fin 502-1302 models is 75 GPM.

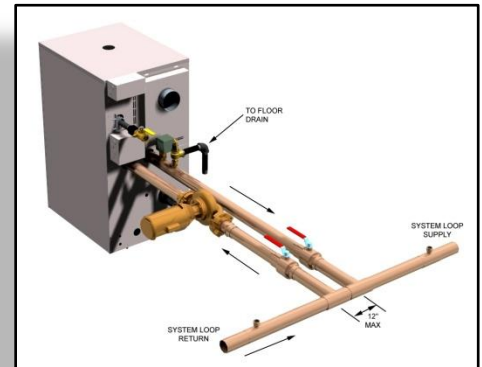
The maximum flow rate for the Power-fin 1501-2001 models is 90 GPM.

Water

Because system flow rates and boiler flow rates need to be controlled separately, you will want to design a Primary / Secondary piping loop. The Primary Loop, hereafter referred to as the "System Loop" flows water around the building. The Secondary Loop, hereafter referred to as the "Boiler Loop" branches off the system loop to flow water into and out of the boiler. The purpose of System / Boiler Loop piping is to separate or "decouple" the system flow rate from the boiler flow rate.

The System Loop will have its own dedicated pump flowing at one flow rate and the separate Boiler Loop will have its own dedicated pump to flowing into and out of the boiler. The Boiler pump is sized based on the head loss of the boiler and related pipe and fittings in the Boiler Loop only.

Multiple boilers may also be installed with a System / Boiler Loop format with a manifold system that connects the multiple boilers to the System Loop. Multiple boilers should be connected to the common manifold in reverse return to assist in balancing flow to multiple boilers. See diagram A2 on page 38.



Reference Drawing A1 – Page 37

BOILER CIRCULATOR REQUIREMENTS

Again, there will be a minimum of two pumps in a System / Boiler Loop. Both pumps are provided by the installer. The boiler pump must be sized to provide adequate flow through the boiler and the Boiler Loop piping. A Boiler Temperature Rise Chart is provided to assist in proper pump selection. This table provides GPM and boiler head-loss at various temperature rises for each model based on Btu/hr input. Pipe diameter and length are critical to ensure proper flow through the boiler. From the table, choose the temperature rise and the flow rate for best operation of the boiler.

BOILER TEMPERATURE RISE CHART															
Input	Output	30°FΔT		35°FΔT		40°FΔT		45°FΔT		50°FΔT		55°FΔT		60°FΔT	
		GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd	GPM	Ft/hd
500,000	435,000	29.0	0.9	24.9	0.7	21.8	0.5	19.3	0.4	17.4	0.3	15.8	0.2	14.5	0.1
750,000	652,500	43.5	2.1	37.3	1.8	32.6	1.3	29.0	1.0	26.1	0.8	23.7	0.7	21.8	0.6
1,000,000	870,000	58.0	4.8	49.7	3.3	43.5	2.4	38.7	2.0	34.8	1.6	31.6	1.2	29.0	1.1
1,300,000	1,131,000	75.4	9.8	64.7	6.9	56.6	4.6	50.3	3.6	45.3	2.9	41.1	2.2	37.7	1.9
1,500,000	1,275,000	87.9	9.8	75.3	7.7	65.9	6.3	58.6	5.2	52.9	4.2	47.9	3.3	43.9	2.7
1,700,000	1,445,000	99.6*	14.1	85.4	10.2	74.7	7.9	66.4	6.5	59.8	5.3	54.3	4.6	49.8	3.9
2,000,000	1,700,000	117.2*	20.2	100.4*	14.9	87.9	11.9	78.1	9.2	70.3	7.2	63.9	6.4	58.6	5.2

* The Asterisk indicates flow rates that exceed the Maximum Allowable Flow Rate of the Heat Exchanger and must not be used.

ADDITIONAL CIRCULATOR PUMP SPECIFICATIONS

1. Maximum operating pressure for the pump must exceed system operating pressure.
2. Maximum water temperature should not exceed the nameplate rating.
3. Cast iron circulators may be used in closed loop systems.

Important

THE BOILER PUMP MUST BE A CONTINUOUS SPEED PUMP THAT KEEPS A CONSTANT FLOW THROUGH THE BOILER.

WATER FLOW

Now Minimum Flow Rate.

Is the minimum planned flow rate for the system loop below that of the minimum allowable flow rate through the boiler?

The lowest potential System Loop Flow Rate MUST be 25% greater than the Boiler Loop flow rate.

LOW SYSTEM FLOW RATE

The use of System / Boiler Loop piping is used to separate the higher system flow rate from the lower boiler flow rate. But what about low system water flow? Doesn't the System / Boiler Loop piping protect the boiler during low system flow? Not if the system flow rate drops below the flow rate chosen for the Boiler loop.

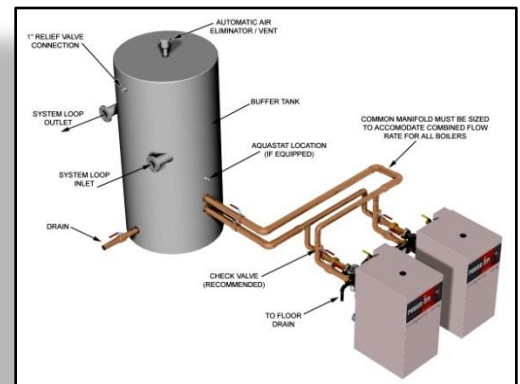
Here's what happens. The boiler flow rate will backfeed down the System line and recirculate taking the path of least resistance. This means the boiler is recirculating already heated water in a very small volume.

We mention this because this dynamic is occurring more and more often as we see Variable Speed pumps and 3-way valves used in System Loop piping. The principle of the variable speed pump or 3-way valve is to increase or decrease flow rates through the System Loop as building demand changes. Good for the system but not so good for the boiler. If the system's flow rate is ever 25% lower than the boiler flow rate, it is highly recommend you use a Buffer tank.

BUFFER TANK

A buffer tank solves this problem. The buffer tank adds water volume at the point where the System Loop and the Boiler Loop meet. Classic System / Boiler Loop piping isolates the flow rates well but a Buffer tank will isolate the flow rates completely and add water volume to provide a stronger "decoupler" for the boiler.

Refer to Lochinvar's "Buffer Tank / Air Eliminator" product brochure for a tank selection chart or visit the Lochinvar website for a fully automated tank sizing program.



Reference Drawing A3 – Page 39

WATER TEMPERATURE

This is another easy question.

What is the return water temperature from the System Loop?

The minimum return water temperature to the Power-fin boiler is 140°F (60°C).

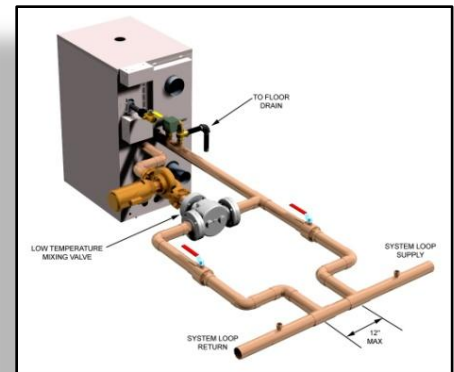
Reason why? If the inlet water temperature is less than 140°F, condensate will occur on the outside of the copper-finned tube and in between the fins. The condensate will collect particles from the flue products. The moisture and particles build up over time and ultimately will clog the fins. This leads to improper combustion, sooting, elevated temperatures and premature failure of the heat exchanger.

Boiler systems that operate on loop temperatures above 140°F are common. But even high temperature systems can occasionally drop below 140°F. For the purposes of energy efficiency, Night Setback is a control feature growing in popularity. Night Setback is a feature built into the Power-fin's Smart System control that can potentially drop system temperatures below 140°F. Also, low system temperatures occur on the comparatively warm days at the beginning and the end of the boiler season. Plus there are Radiant Floor systems and snow melt systems which routinely operate at temperatures below 140°F.

Operation at lower than specified water temperatures may cause hazardous conditions that result in non-warrantable damage to the appliance. However, Lochinvar has an elegant solution, a Low-Temperature Valve.

Low Temperature Valve (LTV)

Lochinvar's Low Temperature Valve is a fast acting, self contained mixing valve, set to 140°F (60°C). This valve, properly installed, will maintain the required 140°F temperature through the boiler regardless of system temperature.



Reference Drawing A4 – Page 40

WATER VOLUME

The idea is to keep an amount of water in the system to support the heating capacity of the boiler during the lowest possible demand.

What is the minimum Btu/hr system demand?

The minimum system demand must be GREATER than the minimum boiler output.

The standard model Power-fin "M9" boiler has a 5:1 Turndown ration. Or a minimum Btu/hr output rate down to 20% of the heater's total output rate. That will increase our chances of the boiler's Btu/hr output rate being below the system demand.

Example:

Imagine an installation consisting of three air handlers with 400,000 Btu/hr rated heating coils for a total demand of 1,200,000 Btu/hr system demand. The system is heated by two Power-fin 0752 boilers for a total input of 1,500,000 Btu/hr. Each boiler is the standard "M9" model that fires at 5:1 Turndown.

On a very cold winter day, all three air handlers will call for heat and the two Power-fin will fire at 100% input rate to meet the demand. On a comparatively cool autumn day, only one 400,000 Btu/hr air handler might be calling for heat. The boilers, connected together with their Smart System controls will fire only one boiler at its reduced input and output rate. The minimum 20% output rate of a single Power-fin 0752 is 127,000 Btu/hr well below the 400,000 Btu/hr minimum system demand. The Power-fin 0752 will actually fire closer to 63% of its potential modulation rate to meet this minimum system demand.

As you can see, the M9 models with their low turndown ratio have an improved capacity to fire below the minimum system demand. But the issue of water volume is still a consideration with the F9 models which fires at a 100% On/Off firing rate and with the B9 models that fire at a minimum 50% rate.

The following table shows the maximum and minimum input and output rates for every Power-Fin with all of the available Firing Codes. Calculate the minimum load of your design to make sure the system demand or system volume will support minimum boiler output rate.

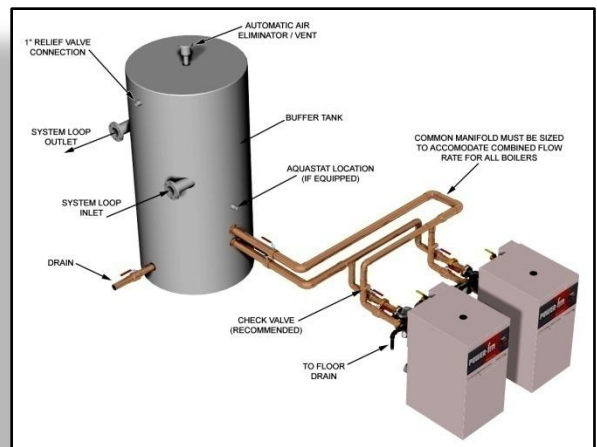
MODEL NUMBER	MAXIMUM INPUT	MAXIMUM OUTPUT	MINIMUM INPUT	MINIMUM OUTPUT
PB(N,L)0502-F9	500,000	425,000	500,000	425,000
PB(N,L)0752-F9	750,000	637,000	750,000	637,000
PB(N,L)1002-F9	1,000,000	850,000	1,000,000	850,000
PB(N,L)1302-F9	1,300,000	1,105,000	1,300,000	1,105,000
PB(N,L)1501-B9	1,500,000	1,260,000	750,000	630,000
PB(N,L)1701-B9	1,700,000	1,428,000	850,000	714,000
PB(N,L)2001-B9	2,000,000	1,680,000	1,000,000	840,000
PB(N,L)0502-M9	500,000	425,000	100,000	85,000
PB(N,L)0752-M9	750,000	637,000	150,000	127,000
PB(N,L)1002-M9	1,000,000	850,000	200,000	170,000
PB(N,L)1302-M9	1,300,000	1,105,000	260,000	221,000
PB(N,L)1501-M9	1,500,000	1,305,000	300,000	261,000
PB(N,L)1701-M9	1,700,000	1,479,000	340,000	296,000
PB(N,L)2001-M9	2,000,000	1,740,000	400,000	348,000

If the minimum Btu/hr system demand is **SMALLER** than the boiler's minimum Btu/hr output then there may be insufficient water volume. If that is the case, then a Buffer tank is your solution.

BUFFER TANK

The buffer tank adds water volume to the system providing the volume needed to support the minimum output rate of the boiler if the minimum system load can't.

Refer to Lochinvar's "Buffer Tank / Air Eliminator" product brochure for a tank selection chart or visit the Lochinvar website for a fully automated tank sizing program.



Reference Drawing A3 – Page 39

DOMESTIC WATER HEATING WITH THE HYDRONIC HEATING SYSTEM

The Power-fin boiler system can be configured to provide Domestic Hot Water, with the addition of Lochinvar's Hot Water Generator Systems. The Hot Water Generator is a storage tank fitted with a heating coil. A sufficiently sized boiler will heat both the potable hot water demand and provide source water for the hydronic heating systems. Hot Water Generator Systems use the boiler water as an energy source and can provide high recovery rates, making them an economical water heating system.

Chapter 5 – Electrical & Controls

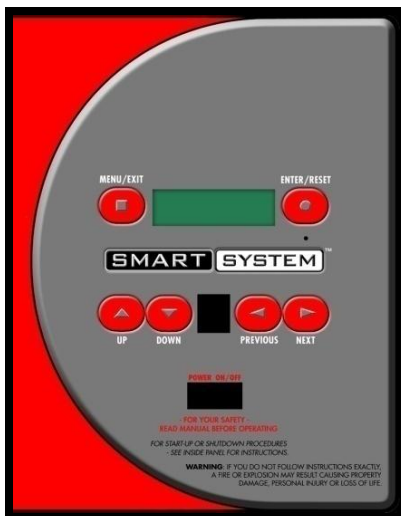
The first idea for this chapter is supplying power to the boiler. A 120 VAC, 15 Amp, 1 ph, 60 Hz circuit is required for operation of the boiler.

The boiler, when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction, or in the absence of such requirements, with the latest edition of the National Electrical Code ANSI/NFPA No. 70. When the unit is installed in Canada, it must conform to the CAE C22.1, Canadian Electrical Code, Part I and/or local Electrical Codes.

1. All wiring between the appliance and field installed devices shall be made with type T wire [63°F (35°C) rise].
2. All voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.
3. The appliance must be provided with proper overload protection.

AMP DRAW DATA			
Btu/Hr Input	Blowers & Controls	Pump FLA	Total Amps 120 VAC
PB(N,L)0502	6.7	8.8	15.5
PB(N,L)0752	6.7	8.8	15.5
PB(N,L)1002	6.7	8.8	15.5
PB(N,L)1302	6.7	8.8	15.5
PB(N,L)1501	6.5	8.8	15.3
PB(N,L)1701	6.5	8.8	15.3
PB(N,L)2001	6.5	8.8	15.3

Electricity & Controls



SMART SYSTEM CONTROLS

The Power-fin features the Smart System control. The Smart System control is designed to operate all the various elements of a hydronic heating system plus Domestic Hot Water. The Smart System control can operate the boiler pump, the system pump and the DHW pump. It has outdoor reset as standard equipment. But its best feature is Cascade, the organized control of up to eight separate boilers.

The Smart System control is designed to provide many of the operating features of a remote Building Management System thereby eliminating one more expensive component in your system design.

BUILDING MANAGEMENT SYSTEM CONTROL

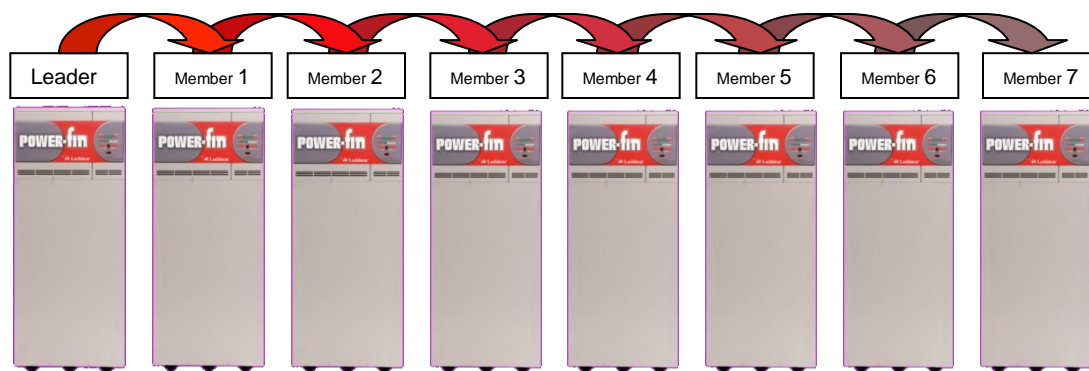
For systems with more that eight Power-fin boilers or for systems with existing Building Management Systems, the Power-fin boiler is programmed to operate via a remote signal. A 0-10 Vdc input signal will control the boilers. The signal can be programmed to call the boilers to fire on a range of modulation or on a temperature range.

CASCADE

The Cascade feature in the Smart System control will operate up to eight boilers. Connected with 2-wire Daisy chain, any one boiler in the group is chosen as the Leader. The other boilers operate as Members. The Leader boiler makes the decision on which boiler is firing and at what rate to meet the demand.

Each day, a different boiler is assigned the role as first in the firing sequence. This built-in "Lead-Lag" feature distributes even usage over the life of the boilers. The Cascade function also operates with Outdoor Reset to increase system temperature as the outside temperature decreases.

Built-in Cascade of up to eight boilers



PUMP CONTROL

If the Smart System control is going to control up to eight boilers with Cascade or operate from a BMS signal, it is only reasonable for the Smart System control to operate the circulator pumps. All three are wired through the High Voltage Terminal strip. All three pumps are field supplied. The terminal strip is rated for 1 HP pumps maximum. For larger horse power pumps, plan to insert a switching relay or contactor to decouple the pump from the terminal strip contacts.

Boiler Pump Control

The Smart System control will activate and deactivate the pump for each System Heating call for heat. Intermittent pump operation. 30 second pump delay (programmable).

System Pump Control

The Smart System control will activate and deactivate the pump for each System Heating call for heat. Intermittent pump operation. 30 second pump delay (programmable).

DHW Pump Control

The Smart System control will activate and deactivate the pump for each DHW call for heat. Intermittent pump operation. 30 second pump delay (programmable).

OTHER HIGH VOLTAGE TERMINAL STRIP CONNECTIONS

Alarm on Any Failure Contacts

Should the Smart System control detect a fault, it will send an alarm signal through these dry contacts to a remote control board or activate an alarm bell.

Run Time Contacts

The Smart System control will "make" these dry contacts for the duration of the Main Burner.

LOW VOLTAGE TERMINAL BOARD

Every Power-fin is equipped with a Low Voltage Terminal Board for a variety of other field connections and control features.

Remote Enable / Disable

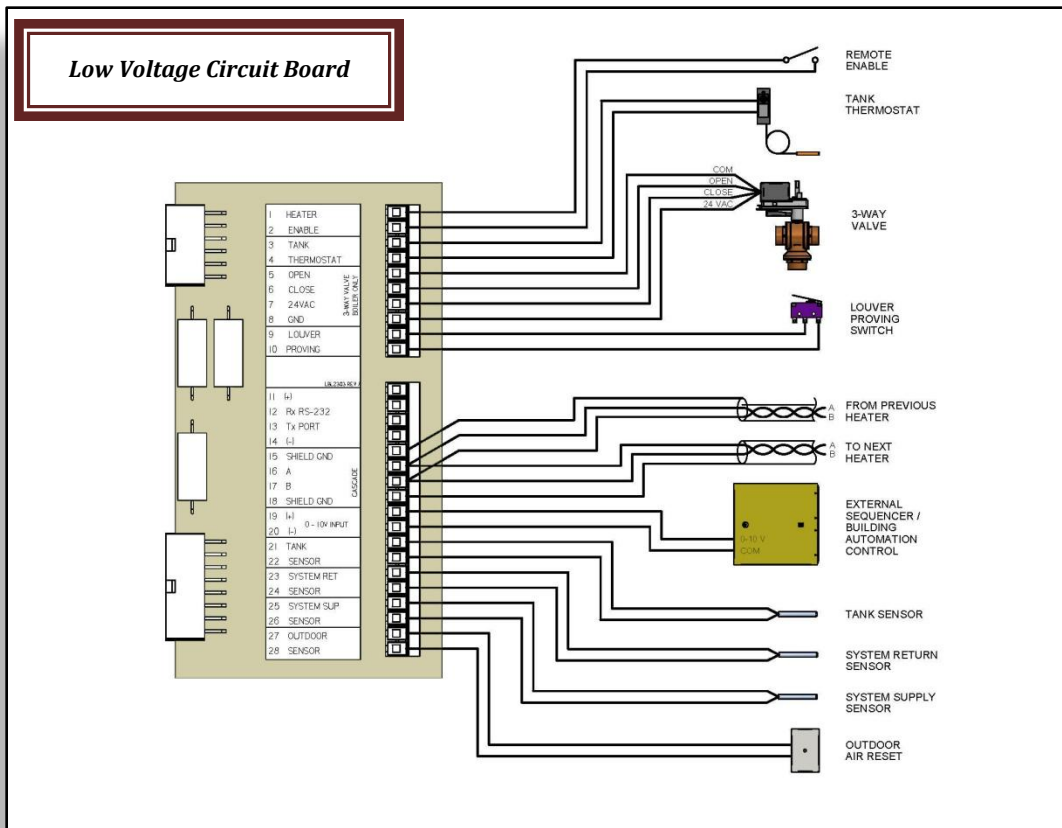
Wired through the Low Voltage Terminal Strip, the Smart System control can be activated by a remote thermostat or controlled with an enable / disable signal.

DHW Mode via Sensor or Thermostat

The Smart System control will operate the DHW based on a signal from a tank sensor with a resistance signal or a tank thermostat with an enable / disable signal.

3-way Valve

The Smart System control will actuate a three way valve to maintain 140°F inlet water temperature.



Louver Contacts

The Smart System control will open and close equipment room louvers on a call for heat with Louver Proving Switch for control safety.

Cascade

Previously noted, up to eight boilers can be connected to one another and programmed for sequenced operation, including Domestic Hot Water.

BMS Control with 0-10 vdc Input

The Smart System control can be activated by a Building Management System with a 0-10 Vdc signal. The signal can control either the setpoint or the modulation directly. It can control a single boiler, or boilers in cascade.

DHW Tank Sensor

A sensor mounted in the Domestic Water Storage tank. The Smart System will operate the DHW from this sensor.

System Return Sensor

A sensor mounted in the return line of the primary system loop BEFORE flow branches to the secondary boiler loop. When the Smart System is programmed to operate off the inlet sensor, and the system return sensor is connected, it will control the firing rate based on this sensor. This sensor should be used whenever inlet temperature control is programmed, and a hydro-separator or low-temperature bypass is installed.

System Supply Sensor

A sensor to be mounted in the supply line of the primary system loop. When the Smart System is programmed to operate off the outlet sensor (default setting), and the system supply sensor is connected, it will control the firing rate based on this sensor. This sensor should always be installed, even when inlet temperature control is programmed for control.

Outdoor Air Reset with Outdoor Sensor

A sensor mounted outside the building. The Smart System control will adjust system temperature based on this sensor.

Tip



DRAW THE SENSORS AND THE SENSOR LOCATIONS INTO YOUR BUILDING AND PIPING PLANS.

SMART SYSTEM OPERATIONAL FEATURES

The following is a list of just a few of the many other operational features built-in to the Smart System control. For the complete list of features with more detailed explanations plus programming parameters, refer to the Installation & Operation Manual, the Service Manual or the User Manual.

Clock

The Smart System has a clock for date and time. This must be set for record keeping and night setback functions.

DHW Priority

On a DHW call for heat, the Smart System control will interrupt a SH call for heat, switching off the boiler pump and turning on the DHW pump.

Freeze Protection

The Smart System control automatically monitors the water temperatures and will operate the pump and if necessary, fire the appliance to protect the heat exchanger from freezing.

Inlet Water Temperature

The Smart System will monitor inlet water temperature and report consistent flow of water less than 130°F which will cause condensation in the heat exchanger.

Anti-Cycling

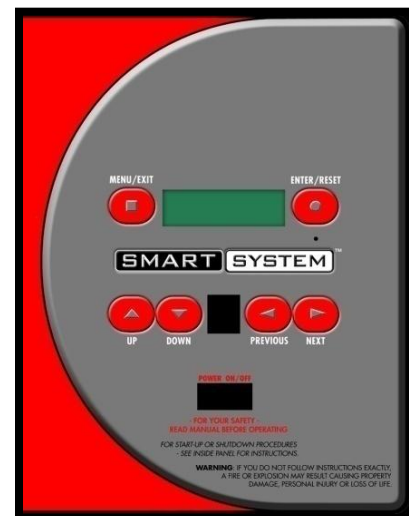
The Smart System control will monitor burn cycles and force a minimum off time to reduce short cycling.

Night Setback

The Smart System will reduce the SH or DHW setpoints during periods where the building is unoccupied. This is a programmable parameter.

Service Reminder

The Smart System control can display a reminder to the customer that it is time for a service call. This time frame is a programmable parameter.



AND MORE

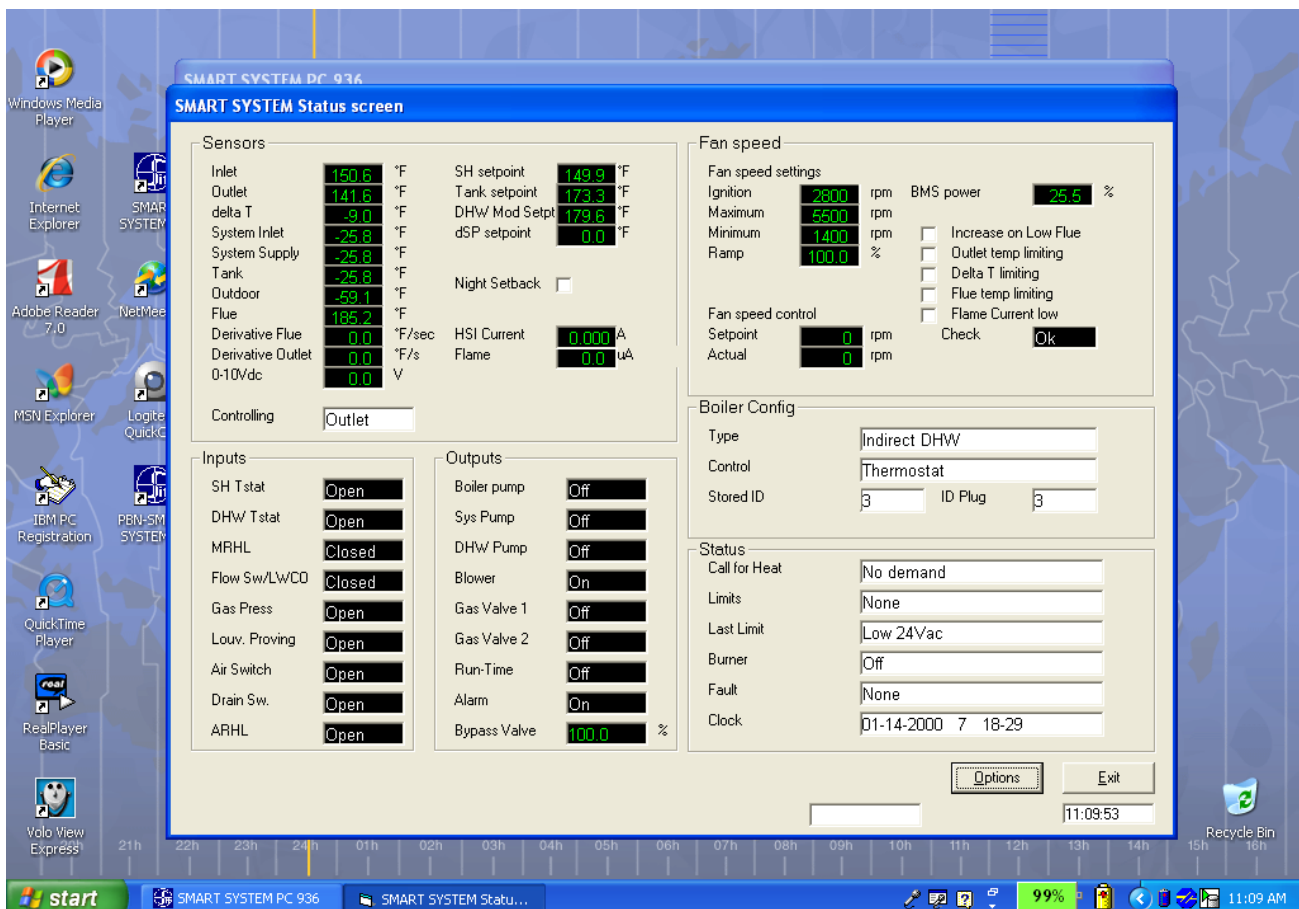
Open / Shorted Sensor Detection
Fan Speed Low & Fan Speed High
Flame Current Support
Flue Temperature Limiting
Outlet Temperature Limiting
DHW versus SH Cycling
Low Voltage Blocking

Monitoring of Safety Devices
Ramp Delay
Run Time and Cycle Count
Temperature Rise Limiting
Gradient Limiting
High Limit Operation
Low Water Cutoff Protection

PC SOFTWARE

All of these features are built into the Smart System control standard on every model. But to help you see them better, Lochinvar offers PC Software. The PC software program can be downloaded onto a laptop computer and with the connection cable provided in the PC Software kit; you can connect to the PC port on the front of every Power-fin control panel.

SCREEN SHOT OF PC SOFTWARE



Chapter 6 – Other Details of Great Importance

STANDARD CODES, STANDARD CONSTRUCTION

The Power-fin boiler is design certified to the latest edition of ANSI Z21.13. The third party certification was performed by CSA International and the boiler bears the American Blue Star emblem and the Canadian Blue Flame emblem. The heat exchanger inside the boiler conforms to the latest edition of the ASME Boiler and Pressure Vessel Code, Section IV and the vessel bears the ASME "H" Stamp.

The installation of a heating boiler is governed by local boiler codes. The boiler shall be installed in accordance with those installation regulations and shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made. The local code may require a feature on the boiler above and beyond the ANSI requirements. Check the list of factory installed options on page 35. Again, these options are factory installed and must be specified on the original purchase order. Review the local code especially in regard to the venting requirements.

In the absence of local codes, U.S. installations shall conform to the latest edition of the National Fuel Gas Code, ANSI Z223.1. In Canada, the installation must comply with the Canadian Gas Association Code, CAN/CGA-B149.1 and/or B149.2 and/or local codes.

Details



CSA International
Blue Star for United States



CSA International
Blue Flame for Canada



ASME, Section IV
"H" stamp for Boilers

OPTIONAL CODES, ADDITIONAL CONSTRUCTION

Many local authorities require the boiler installation conform to CSD1, the American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers. CSD-1 is subject to different interpretation by different boiler inspection offices. The Power-fin boiler must be factory trimmed to meet CSD-1 code to client specifications.

Factory Mutual is a popular insurance code and the Power-fin boiler must be factory trimmed to meet Factory Mutual. The well known Industrial Risk Insurers code has been purchased by General Electric Company and replaced with their own "GE Gap" code.

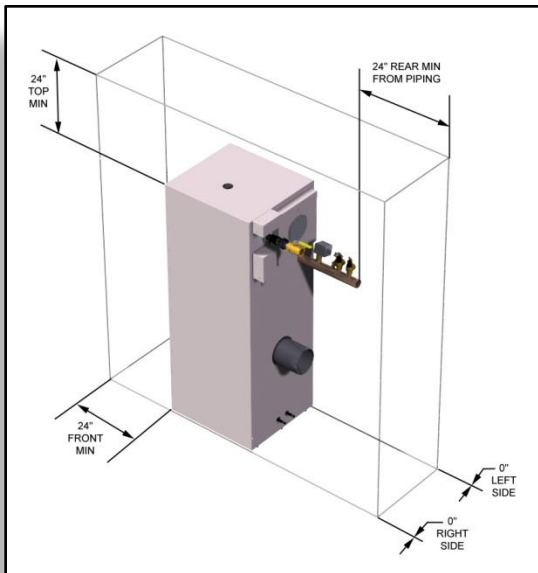
The Power-fin boiler must be factory trimmed to meet Factory Mutual or GE Gap to client specifications.

STATE CODES, ADDITIONAL CONSTRUCTION

All states have their own boiler installation code, but some states have codes that require special equipment on the boiler itself. Currently, California, Massachusetts, Minnesota and Kentucky have state codes that require additions to Lochinvar products. Check with your local Lochinvar sales office or Lochinvar Customer Service for details.

DETERMINE THE UNIT LOCATION

1. Locate the appliance so that if water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the unit. The pan must not restrict combustion airflow.
 Under no circumstances is the manufacturer to be held responsible for water damage in connection with this unit, or any of its components.
2. **DO NOT** install this appliance in any location where gasoline or flammable vapors are likely to be present.
3. The appliance must be installed on a level floor. Combustible floor locations may be used. Maintain required clearances from combustible surfaces.
4. The appliance must be installed indoors where it is protected from exposure to wind, rain, and weather.
5. This appliance may condense the products of combustion if operated at water temperatures below 140°F (60°C). Ensure that the appliance is located near an acceptable drain where condensate that may form in the venting system can be properly collected and disposed.
6. Access to the rear of the appliance **MUST** be maintained.

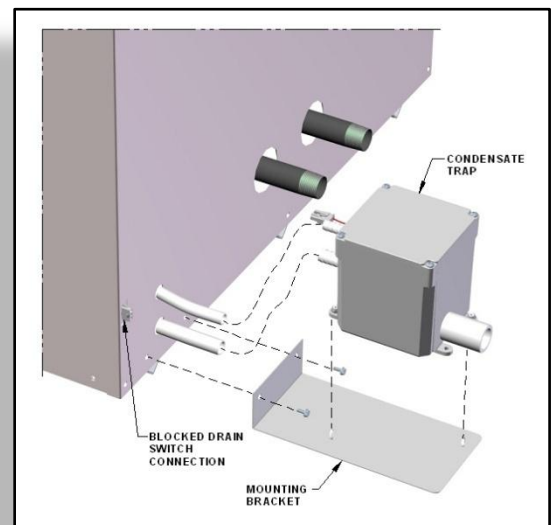


CLEARANCES FROM COMBUSTIBLE CONSTRUCTION	
Right Side	Zero inches
Left Side	Zero inches
Rear	6" (Minimum 24" suggested for service to the pump and other components)
Front - Alcove*	(Minimum 24" suggested for service)
Top	6" (Minimum 24" suggested for service)
Flue	2"
Hot Water Pipes	1"

*An Alcove is a closet without a door.

CONDENSATE TRAP

The Power-fin is fitted with a condensate trap to be field mounted on the floor behind the appliance. The trap is a requirement of the ANSI standard for any Category IV vented appliance with condensation forming in the stack.



HIGH ALTITUDE APPLICATIONS

Atmospheric pressure decreases as the height above sea level increases. At any altitude above sea level, a cubic foot contains less gas than a cubic foot at sea level. Thus, the heating value of a cubic foot of fuel gas will decrease as height above sea level increases. Therefore a recalculation of heat input rate should be performed on any appliance beginning at 2000 feet. Ratings should be reduced at the rate of 4 percent for each 1000 feet above sea level. The Power-fin boiler must be factory trimmed for installation at an altitude range GREATER than 4000 feet above sea level.

FACTORY INSTALLED OPTIONAL EQUIPMENT

Lochinvar provides the following selection of optional equipment to meet your building requirements.

Alarm Bell

Factory installed onto the back of the appliance and wired to the Alarm on Any Failure contacts. It will sound on any failure. A silencing switch is provided. Alarm on Any Failure contacts are standard on every Power-fin boiler for connection to a remote alarm bell or Building Management System.

High & Low Gas Pressure Switches with Manual Reset

The switches are mounted just inside the upper front chamber. The High Gas Switch will interrupt the call for heat should high gas pressure be sensed in the gas line. The Low Gas Switch will interrupt the call for heat if the gas pressure supplied to the appliance is too low to achieve a safe burner flame. Both switches require manual reset to restart the appliance. The High and Low Gas Pressure Switches with Manual Reset is part of the Factory Mutual, GE Gap or CSD1 option packages.

Low Water Cut-Off, Probe Type with Manual Reset

The electronic board is mounted in the control panel with a sensing probe mounted in the top header of the heat exchanger. The LWCO is set to interrupt the call for heat if a low water condition is sensed. The LWCO requires manual reset to restart the appliance. This is offered for many local codes that do not accept the standard-equipped flow switch as a low water cut off device. Check with local code authorities for acceptance of the standard flow switch as a low water cut off device.

Low Temperature Valve

As described on page 26 in the "Water" chapter, Lochinvar offers a Low Temperature Valve to be piped into the secondary loop to control water temperature returning to the boiler. The LTV Valve is a ship-loose item and will not be physically attached to the boiler.

Cupro-Nickel Heat Exchanger

90% copper, 10% nickel, the Copper-Nickel Heat Exchanger is a harder alloy than the standard copper-tubed heat exchanger and is suggested for chemically treated water and for hard water conditions.

Relief Valve

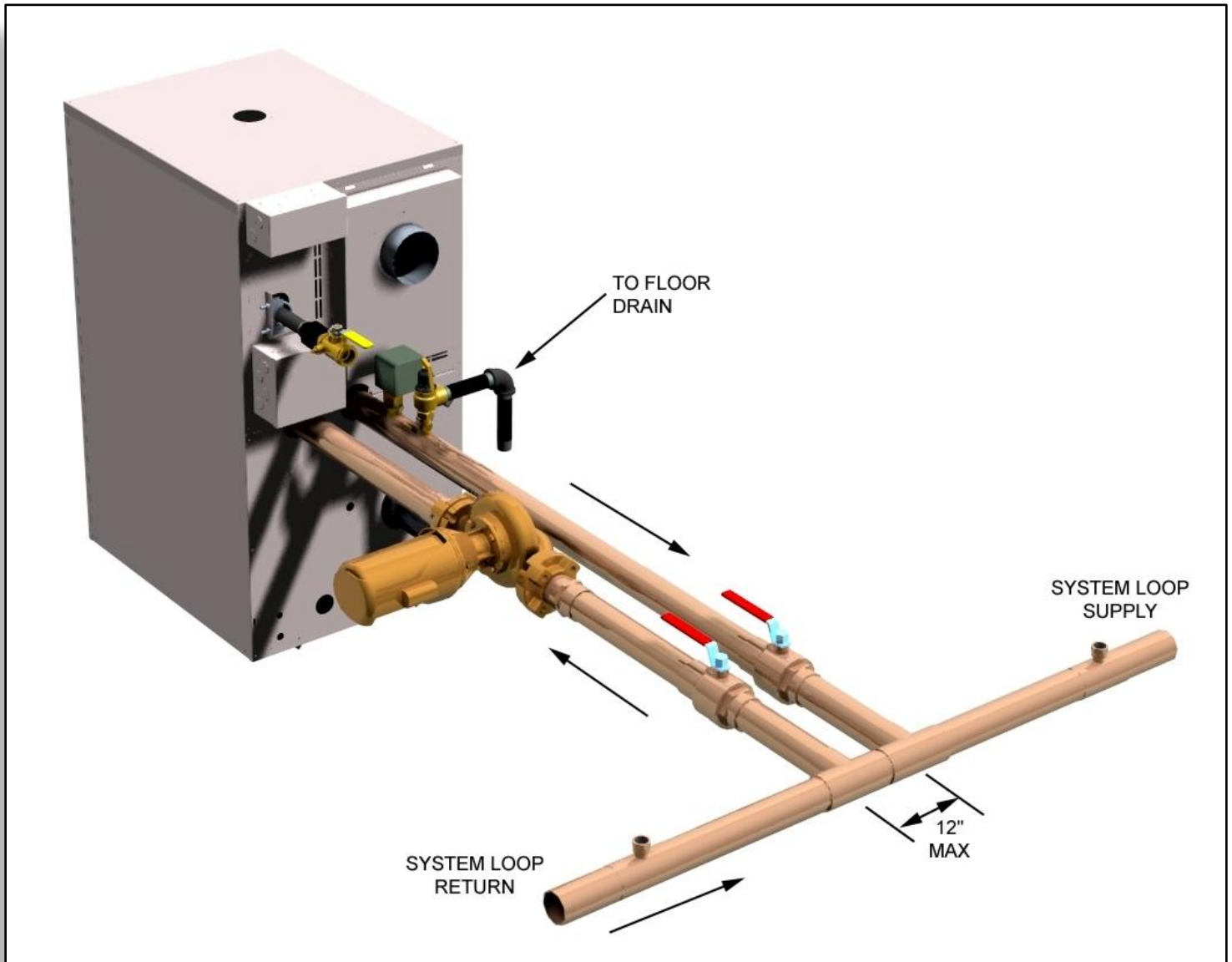
The standard relief valve offered on the Power-fin boiler is a 50 psi Pressure Only ASME relief valve. The Power-fin can be factory trimmed with a pressure only ASME relief valves with a higher pressure ratings of your choosing.

Appendix A

Boiler Piping Diagrams

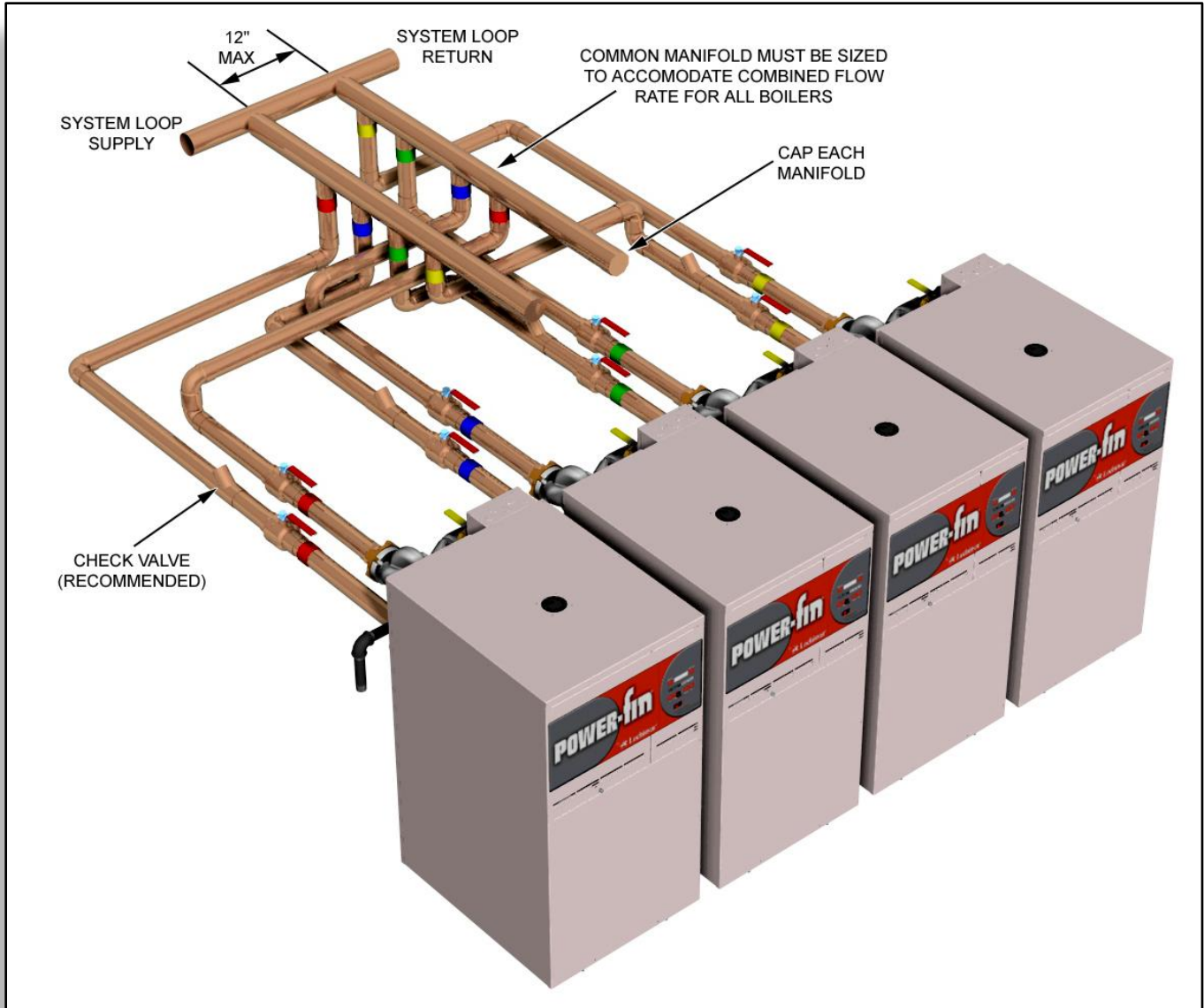


PAGE A1
PRIMARY/SECONDARY or SYSTEM/BOILER PIPING



The illustration is for concept only and should not be used for actual installation without engineering or technical advice from a licensed engineer. All necessary system equipment may not be illustrated.

MULTIPLE UNIT – PRIMARY/SECONDARY or SYSTEM/BOILER PIPING



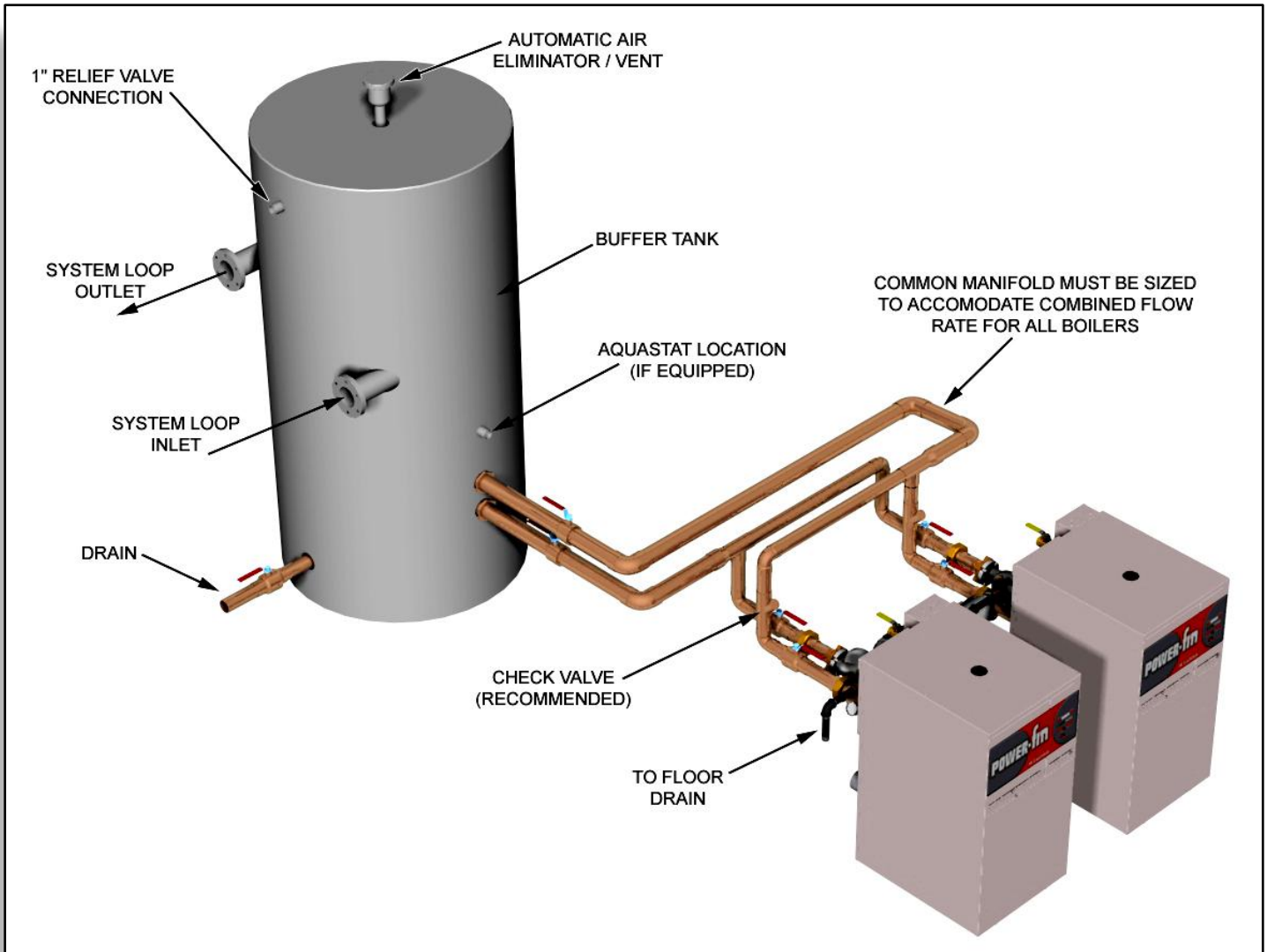
Power-fin 0502, 0752, 1002 & 1302

Number of Units	Combined GPM	Common Manifold Pipe Diameter
2	150	3-1/2"
3	225	4"
4	300	5"
5	375	6"
6	450	6"
7	525	6"
8	600	7"

Power-fin 1501, 1701 & 2001

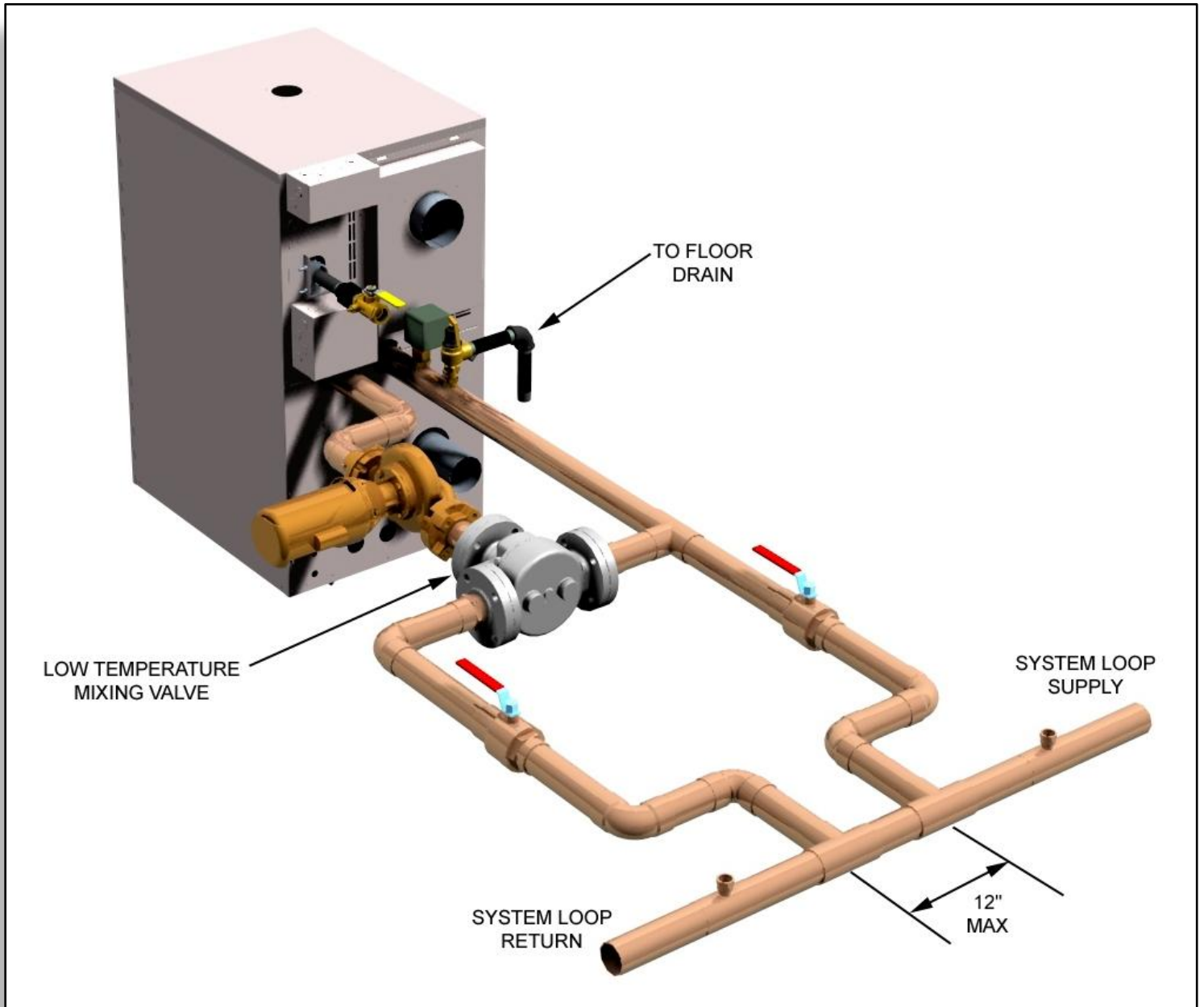
Number of Units	Combined GPM	Common Manifold Pipe Diameter
2	180	4"
3	270	5"
4	360	6"
5	450	6"
6	540	6"
7	630	7"
8	720	7"

PAGE A3
BUFFER TANK



The illustration is for concept only and should not be used for actual installation without engineering or technical advice from a licensed engineer. All necessary system equipment may not be illustrated.

PAGE A4
LOW TEMPERATURE VALVE PIPING



The illustration is for concept only and should not be used for actual installation without engineering or technical advice from a licensed engineer. All necessary system equipment may not be illustrated.

Appendix B

Technical Data and Boiler Component Breakdown



Power-fin – the components, the design

1. Heat exchanger

The heat exchanger allows system water to flow through specially designed tubes for maximum heat transfer. The glass lined headers and copper finned tubing are encased in a jacket that contains the combustion process.

2. Heat exchanger access cover

The heat exchanger access cover is a stainless steel door which allows access for service, maintenance, and removal of the heat exchanger from inside the combustion chamber.

3. Blower

The blower pulls in air and gas through the venturi (see item 5) and injects the fuel/air mixture into the burner, where they burn inside the combustion chamber.

4. Gas valve

The gas valve allows the proper amount of gas to pass into the burner for combustion. The gas valve on the Power-fin works under a negative pressure so gas should only be pulled through the valve when the blower is in operation.

5. Venturi

The venturi attaches to the inlet (or suction) side of the blower and generates the negative pressure needed by the gas valve.

6. Flue sensor

The flue sensor is mounted in the exhaust collar of the unit and monitors the flue gas temperature. If the temperature in the stack exceeds the maximum temperature the unit will shut down to prevent a hazardous condition. In B9 models, the flue sensor helps to control the amount of modulation to prevent condensation in the stack.

7. Outlet temperature sensor

This sensor monitors the outlet water temperature. If selected as the controlling sensor, the appliance will maintain set point by adjusting the firing rate of the unit according to this sensor.

8. Inlet temperature sensor

This sensor monitors inlet water temperature. If selected as the controlling sensor, the appliance will maintain set point by adjusting the firing rate of the unit according to this sensor.

9. Manual shutoff valve

Manual valve used to isolate the unit from the gas supply.

10. Electronic display

The electronic display consists of 7 buttons and a dual line 32-character liquid crystal display used to monitor the operation of the heater as well as enter and view the programming of the main control board.

11. Burner

The burner is made of a woven fabric over steel screen construction. The burner uses pre-mixed air and gas and provides a wide range of firing rates.

12. Water outlet (system supply)

The water outlet is a 2 1/2" pipe connection that supplies water to the system with connections for a flow switch (see #28), a relief valve (see #25), and a temperature and pressure gauge (see #9).

13. Water inlet (system return)

The water inlet is a 2 1/2" pipe connection that receives water from the system and delivers it to the heat exchanger.

14. Gas connection pipe

The gas pipe connection on this appliance is 1", 1 1/4", or 1 1/2" NPT. To deliver the correct amount of gas volume to the appliance it may be necessary to have a larger gas line and reduce to the appliance connection size at the appliance. Please reference the National Fuel Gas Code charts for more details.

15. SMART SYSTEM Control Module

The SMART System Control Module is the main control for the appliance. This module contains the programming that operates the blower, gas valve, and pumps in addition to other programmable features.

16. Air intake

The air intake pipe allows fresh air to flow directly to the appliance. The air inlet is part of the filter box assembly where air filtration is accomplished with a standard filter.

17. Line voltage terminal strip

The line voltage terminal strip provides a location to connect all of the high voltage (120 VAC) contact points to the unit, such as the contacts to control the boiler or system pumps.

18. Low voltage connection board

The low voltage connection board provides a location to tie in all of the low voltage contacts to the appliance. This is where most of the external safety devices are connected to the unit such as the louver proving switch.

19. Condensate trap

The condensate trap is designed to prevent flue gases from escaping the appliance through the combustion chamber drain.

20. Access cover - front

The front access cover provides access to the gas train as well as the blower and other key components for service and maintenance.

21. Hot surface igniter (HSI)

The hot surface igniter is a device that is used to ignite the air/gas mixture as well as monitor the performance of the flame during operation. This device also acts as a flame sense electrode.

22. Flame inspection window (sight glass)

The flame inspection window is a quartz glass window that allows a visual inspection of the burner and flame during operation.

23. Gas shut off valve (downstream test cock)

The downstream test cock is provided in the gas train to ensure complete shut off of the gas to the burner in case of maintenance, inspection, or testing of the valve.

24. High limit sensor

A device that monitors the outlet water temperature to ensure safe operation. If the temperature exceeds its setting (field adjustable), it will break the control circuit, shutting the appliance down.

25. Relief valve

The relief valve is a safety device that ensures the maximum pressure of the appliance is not exceeded. Boilers operate on pressure only and are shipped from the factory at a rating of 50 PSI.

26. Power switch

The power switch is used to engage and disengage power to the appliance on the 120 VAC circuit.

27. Air pressure switch

The air pressure switch is a safety device which ensures proper blower operation. The air pressure switch is wired in series with the low voltage control circuit in such a way that if the fan does not engage or shuts down prematurely the device will break the control circuit and the unit will shut down.

28. Flow switch

The flow switch is a safety device that ensures flow through the heat exchanger during operation. This appliance is low mass and should never be operated without flow. The flow switch makes contact when flow is detected and allows the unit to operate. If flow is discontinued during operation for any reason the flow switch will break the control circuit and the unit will shut down.

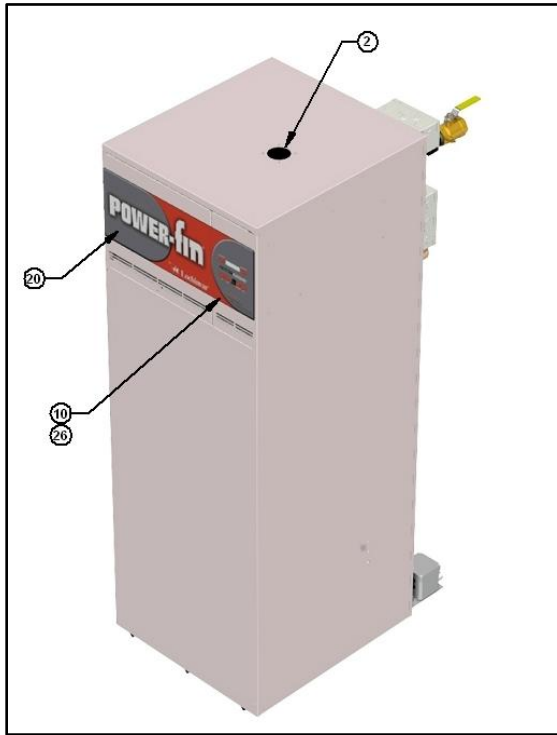
29. Drain port(s)

Location from which the heat exchanger can be drained.

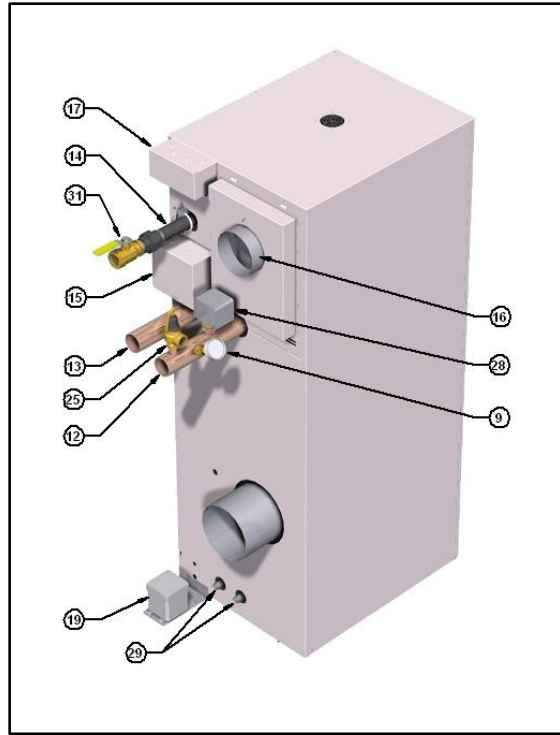
30. Ventilation fan

Provides air circulation around the controls inside the unit.

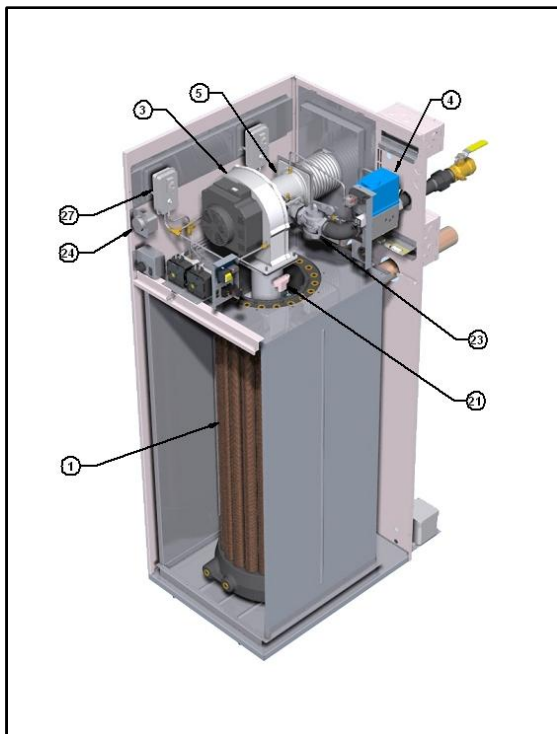
Power-fin 0502 – 1302



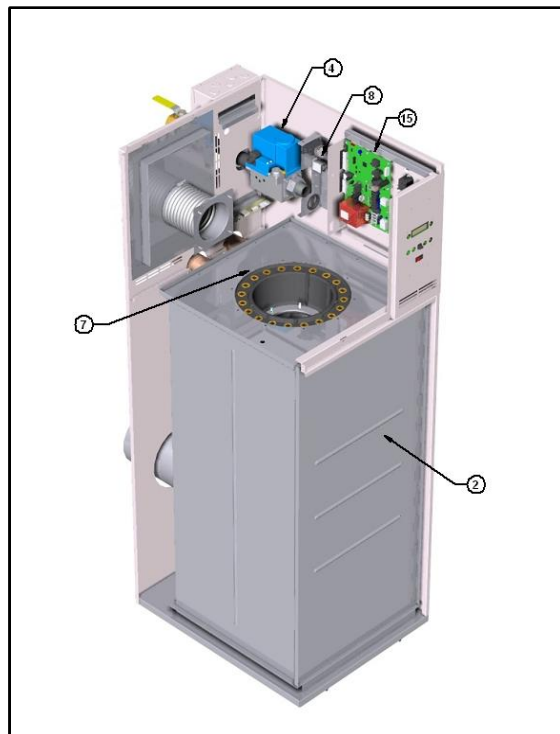
Model 0502 – 1302 / Front View



Model 0502 – 1302 / Rear View

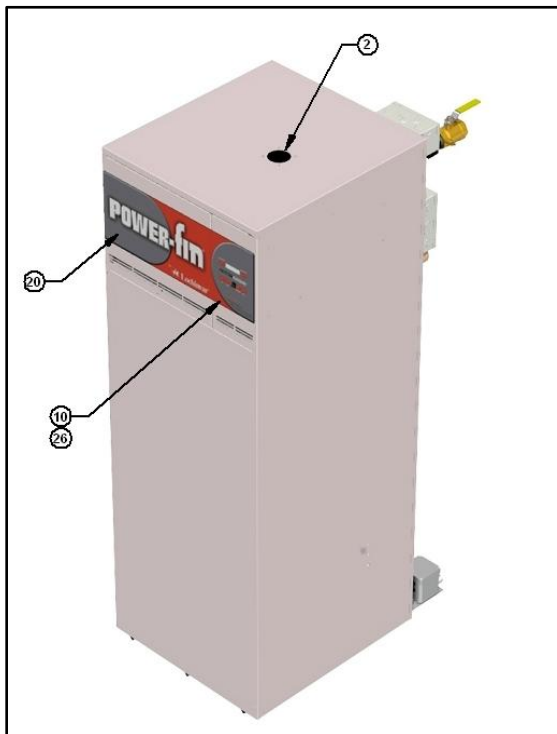


Model 0502 – 1302 / Right Side (inside view)

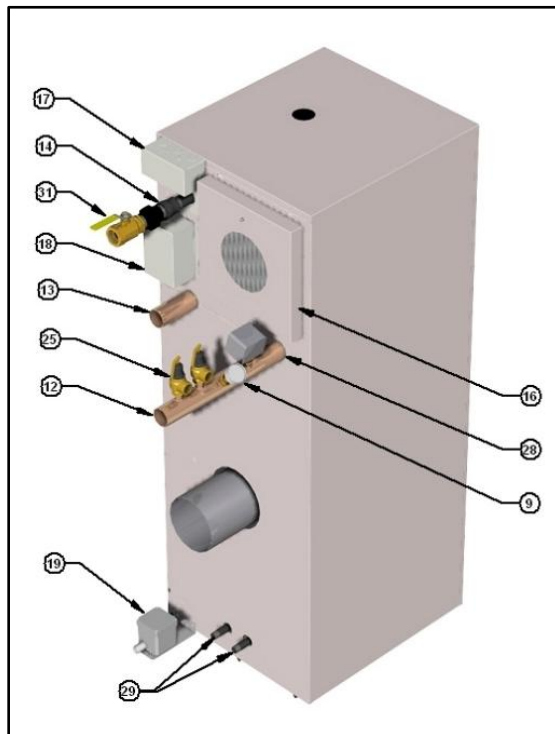


Model 0502 – 1302 / Left Side (inside view)

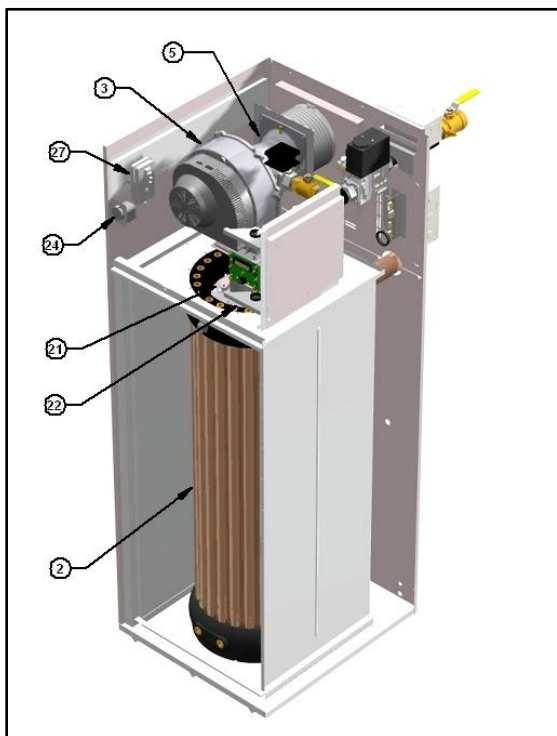
Power-fin 1501 – 2001



Model 1501 – 2001 / Front View



Model 1501 – 2001 / Rear View



Model 1501 – 2001 / Right Side (inside view)



Model 1501 – 2001 / Left Side (inside view)

Go to www.lochinvar.com for more information on all Lochinvar products.

This is a screen shot of the Power-fin webpage. From the home page, click the “Boilers” button on the left side of the page. This takes you to a new page listing all the Lochinvar product families. Click on the Power-fin in the top row.

In this Power-fin webpage, you will be able to download the Installation Manual, the Service Manual, the Power-fin Brochure, Piping Diagrams, Plan View Drawings and much more.



Click here for downloads.



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